SEISMIC SAFETY

AND SAFETY ELEMENTS

OF THE GENERAL PLAN

City of Ripon

Adopted September 16, 1975

The preparation of this report was financed in part through a comprehensive planning grant from the Department of Housing and Urban Development, under the provision of Section 701 of the Housing Act of 1954, as amended and through the auspices of the Council of Intergovernmental Relations, State of California.

SEISMIC SAFETY ELEMENT

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INTRODUCTION

The Seismic Safety Element is a mandatory part of the General Plan. Guidelines prepared by the California Council on Intergovernmental Relations require the identification and appraisal of seismic hazards such as susceptibility to surface rupture, to ground shaking, to ground failure, to the effects of earthquake-induced water waves, and to related geologic hazards such as landslides.

The purpose of this element is to identify and evaluate earthquake hazardous structures and areas; then formulate programs to reduce loss of life, injuries, damage to property, and other impacts resulting from future earthquakes.

The Ripon Seismic Safety element utilizes information and recommendations which apply to the Ripon area contained in the San Joaquin County Council of Governments Seismic Safety Element adopted May, 1973. Recent geotechnical data from the California Division of Mines and Geology, and other sources was also incorporated into the report. Additional information was obtained from city codes and regulations, the Ripon General Plan and Emergency Plan, and from a survey of probable structural hazards in Ripon.

SUMMARY

Historically, very little seismic activity has occurred in the Ripon area in comparison to other parts of California. There are no known active faults or fault traces in the Ripon planning area. The major seismic hazard to Ripon is strong ground shaking and related secondary effects resulting from earthquakes centered on the Calaveras, Midland, San Andreas, Hayward, or Green Valley-Concord fault zones. There is also a possibility of seismic activity along the Stockton-Tracy fault which crosses the county in a northeasterly direction. How active this fault is is questionable, but for purposes of this report, it is conservatively treated as potentially active.

Estimates of maximum credible earthquake intensities which can be expected in Ripon are VIII[1] or IX[2] on the Modified Mercalli Scale. Maximum rock acceleration and probable earthquake duration are estimated in the text of the report. An evaluation of potential landslide activity, liquefaction, subsidence, settlement, seiches, and flooding in Ripon is also made.

CONCLUSIONS

1. The major probable source of seismic hazards occurring in the Ripon area is motion along one of the distant fault systems which have a recent history of activity, e.g., the San Andreas, Calaveras and Hayward faults, and to a lesser extent the Midland and Green Valley faults.

2. The Tracy-Stockton fault, although not precisely located, runs through the central part of the county and has a probability for activity.

3. The maximum earthquake intensity expected in Ripon is VIII[1] or IX[2] on the Modified Mercalli Scale.

4. Maximum credible earthquake magnitutes generated by and on the various fault systems are:

San Andreas	8.3
Hayward	7.5
Calaveras	7.5
Midland	7.0
Green Valley	7.0
Stockton-Tracy	5+

5. Liquefaction is a possibility in the Ripon Planning area. The looser the soil, the shorter the duration and less intense the shaking needed to cause liquefaction.

6. Slope instability along the steep banks of the Stanislaus River is a danger. Because of this and because of flooding danger, the flood plain area along the Stanislaus is not suitable for structures.

7. Flooding in Ripon as a result of seismically-induced dam breakage is a possibility, but a small one. Other than

[1] Urban Geology Master Plan for California, Bulletin 198, Division of Mines and Geology, Sacramento, 1973.
[2] Kleinfelder and Associates, consultants providing technical data for San Joaquin County Council of Governments Seismic Safety Element.

from dam breakage, there is little flooding possibility in Ripon.

8. Seismic hazards do not warrant zoning restrictions with the exception of the Stanislaus River floodplain which should remain in open space, as designated in the adopted Open Space-Conservation Element.

Emergency Services:

1. The Ripon Emergency Plan sets up an organizational structure to be activated in an emergency. It establishes responsibilities of various departments and persons in an emergency. It is coordinated with county and state plans. It organizes emergency communication systems.

2. There is not in existence an inventory of unsafe structures which could endanger public safety in an earthquake.

3. Inundation map data is not yet available from the State Office of Emergency Services. When it is available, it will be included as an appendix to this element.

SEISMIC SAFETY ELEMENT GOALS AND POLICIES
AND IMPLEMENTATION PROGRAM

Goal:

1. To minimize loss of life and damage to property caused by earthquakes.

Policies:

It is the Policy of the City of Ripon that:

1. Type (a)[1] key facilities be designed to remain operational following a maximum credible earthquake.

2. Type (b)[1] key facilities be capable of withstanding a maximum credible earthquake without collapsing or sustaining damage that could cause substantial injury or loss of life.

3. Soils engineering and geologic studies be required in the design of new key facilities.

4. The earthquake provisions of the 1973 Uniform Building Code, and the Dangerous Buildings Ordinance adopted by the city be actively enforced.

5. New subdivision proposals include an evaluation of liquefaction possibilities.

6. No buildings be constructed in the Stanislaus River 100 year floodplain as designated by the Corps of Engineers.

Implementation Program - Recommendations:

The City will:

1. Consider equipping buildings designated as emergency shelters with means for two way communications.

2. Consider evaluating existing key facilities as to

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[1]Key Facilities are those facilities:

a) whose continued performance is very important immediately following an earthquake, i.e., communications facilities, public safety centers, emergency shelters, medical facilities, utilities, and major transportation routes.

b) whose failure could cause large numbers of injuries or deaths, i.e., dams, and high occupancy structures such as schools, auditoriums, churches, meeting halls, large apartments, convalescent homes....

their earthquake susceptibility, and take measures to reduce earthquake hazards found in them.

3. Consider adopting an ordinance to reinforce or abate hazardous architectural ornaments, particularly parapets, cornices, and marquees.

4. Consider having the Building Inspector conduct an inventory of structures (particularly unreinforced masonry) likely to fail in an earthquake (giving priority to key facilities). The inventory should establish a priorities listing of the worst structures based on age, type of construction, structural hazards. From this list, the most dangerous buildings could be abated as the city feels is necessary.

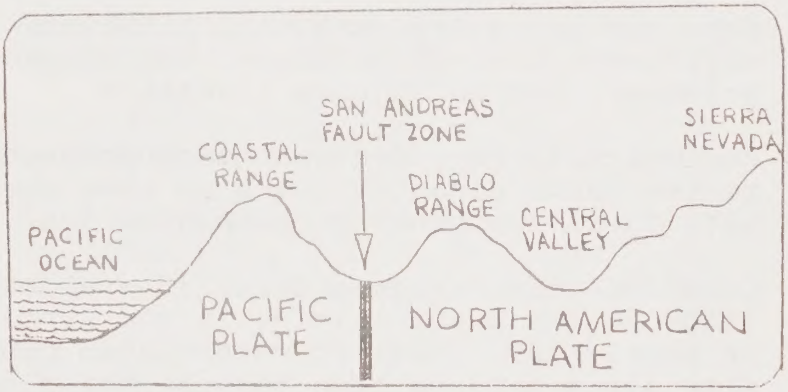
5. Make available informational pamphlets relating earthquake hazards in Ripon, earthquake preparedness measures, and earthquake insurance.

6. Periodically have designated departments and persons review their disaster tasks so they are familiar with their emergency responsibilities.

7. Consider undertaking a detailed evaluation of liquefaction possibilities in the Ripon area which, in particular, looks at water table depths in the City since liquefaction possibilities decrease as the water table deepens.

SEISMIC GEOLOGY AND MEASUREMENT

Earthquakes are caused by the sudden rupturing of the earth along faults (weak portions of the earth's crust). It is believed that this rupturing relieves stress that has been building up in the earth's crust. It is also generally believed that this stress is caused by the movement of plates in the earth's crust. As these crustal plates move against or past one another, stress builds up which causes the crust on the edge of each plate to become deformed. When the stress becomes great enough, the rocks snap along a fault, producing earthquake vibrations.

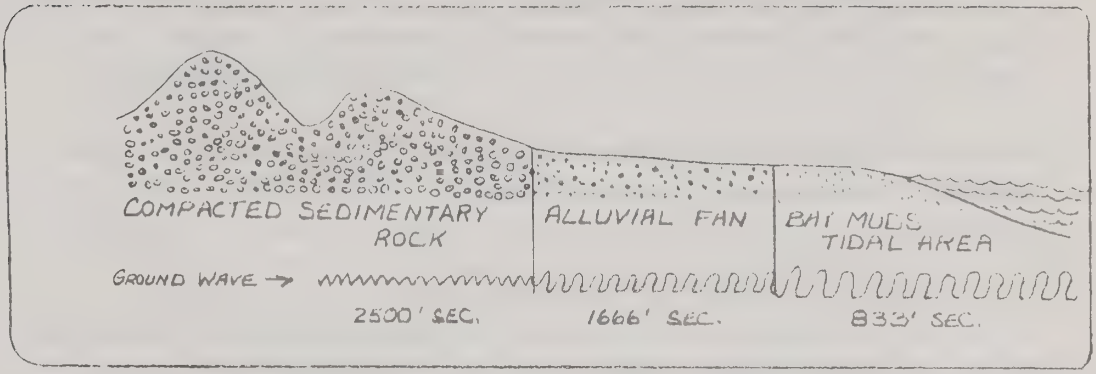


A SIMPLIFIED CROSS SECTION OF SAN ANDREAS FAULT ZONE TO EMPHASIZE LOCATION OF BOUNDARY BETWEEN CRUSTAL PLATES

For Planning purposes there are two kinds of faults: (1) Active faults which have experienced displacement or movement in recent geologic time, suggesting that future displacement can be expected on these faults: and (2) Inactive faults that have shown no evidence of displacement in recent geologic time, suggesting that these faults are dormant. However, some faults labeled as inactive are so termed due to lack of knowledge.

The stress release of an earthquake is expressed in a number of ways on the earth's surface. The most common expression of earthquakes is ground shaking. Ground shaking is a result of surface wave movement through the rock materials of the outer earth's crust. The ground motion created by these seismic waves is not constant. Its direction and speed are directly related to the subsurface soil and rock configuration. Also, surface topography can amplify earthquake waves. As ground waves pass from rock to less dense material (alluvial or water saturated rocks) they

reduce speed and generally increase in amplitude, i.e., the extent of vibration. The result is greater shaking on the surface for a longer period of time with longer, slower vibrations.



GROUND SHAKING WILL LAST LONGER AND HAVE A GREATER AMPLITUDE (EXTENT OF VIBRATION) IN BAY MUDS OR OTHER LOOSELY COMPACTED UNCONSOLIDATED SOILS THAN IN COMPACTED SEDIMENTARY ROCK

Therefore, nearness to a fault and/or rupture does not necessarily determine the intensity and duration of ground shaking that a building should be constructed to withstand. The type, configuration, depth, and density of the underlying soil and rock upon which a building is constructed will determine the maximum vibrational forces the structure should be built to withstand.

For example, two buildings constructed beside each other on different configurations of soil and rock will be subjected to different magnitudes of earthquake shaking even though they are the same distance from the epicenter of the earthquake. Extreme examples of this were noted after earthquakes in Venezuela and Mexico. In Caracas, Venezuela, a modern high-rise building which was constructed next to a masonry, colonial type structure collapsed while the colonial structure remained standing. Likewise, an earthquake originating off the western coast of Mexico in the Pacific Ocean caused slight to moderate damage in cities located between the coast and Mexico City. However, in Mexico City there was extensive damage from the offshore earthquake. Therefore, the degree of ground shaking is not entirely related to nearness to the fault or epicenter. It is also dependent on the composition of underlying soil and rock.

Damage from earthquake shaking is caused by the transmission of earthquake vibrations from the ground into the building structures. The resulting damage is related to the structural design, type of construction, and the intensity, period, and duration of ground shaking. Buildings should be constructed to undergo severe shaking with minimal structural damage from vibrational forces and without collapsing. Buildings should also have systems (lighting, stairwells, communication, etc.) designed to remain functional during and after earthquakes.

In summary, there are five principle elements that influence damage to man-made structures:

1. Strength of the earthquake waves reaching the surface;
2. Length of time of earthquake shaking;
3. Closeness to a fault (generally) although it has been seen this is not always the case;
4. Geologic foundation
5. Building design and construction

Earthquakes are not all the same. They can range from a minor disturbance to a major catastrophic event. How then can we tell the difference between quakes and compare them to each other? The first attempt to classify earthquakes involved a description of their intensity. The scale used to measure the intensity of a quake is the Modified Mercalli Scale with intensities ranging from I to XII. (See Table I)

Intensity is a description of the physical effects of earthquakes. The lowest intensity ratings are based on human reactions, such as "felt indoors by a few." The highest ratings are measured by geologic effects, such as "numerous and extensive landslides." The middle intensity range is based largely on the degree of damage to buildings and other man made structures. Intensity ratings are based on visual observation and are not measured with instruments. The degree of intensity varies from place to place during an earthquake. Specific locations in an area may have an intensity rating of VIII because of soil conditions and type of building structure, while other locations affected by the same earthquake may only have an intensity of IV. Therefore, a single earthquake can have different intensity ratings based on geologic conditions, structural design, or distance from the earthquake epicenter.

TABLE I

MODIFIED MERCALLI SCALE OF EARTHQUAKE INTENSITIES

I. Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced. Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.

II. Felt indoors by a few people, especially on upper floors of multistory buildings, and by sensitive or nervous persons. As in Grade I, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.

III. Felt indoors by several people,usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that due to passing of a light, or lightly loaded truck, or heavy trucks some distance away. Duration may be estimated in some cases. Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.

IV. Felt indoors by many, outdoors by few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside. Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frame creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary cars rock noticeably.

V. Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors. Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerable. pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may

shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.

VI. Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors. Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knick-knacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.

VII. Frightens everyone. General alarm, and everyone runs outdoors. People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe house, old walls (especially where laid up without mortar) spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.

VIII. General fright, and alarm approaches panic. Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperature of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet ground and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.

IX. Panic is general. Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings--some largely collapse. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged, and underground pipes sometimes break.

X. Panic is general. Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts.

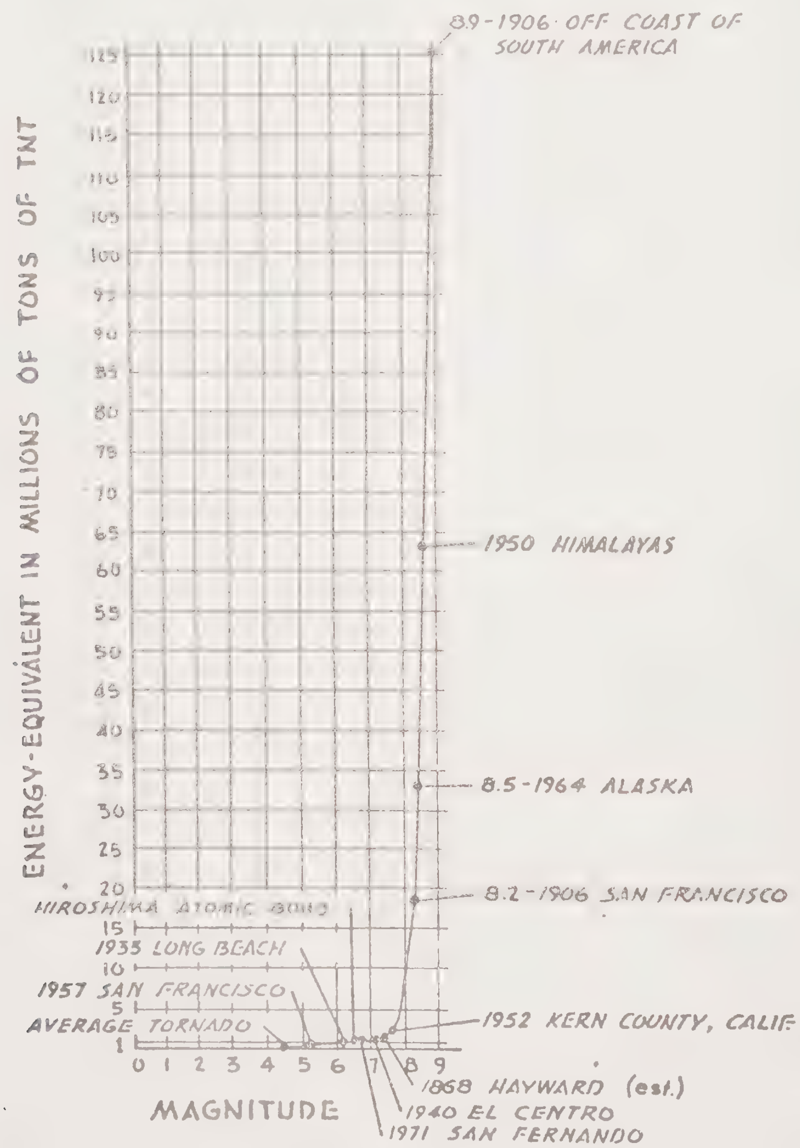
Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations, are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.

XI. Panic is general. Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Damage is severe to wood frame structures, especially near shock centers; great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly, and some thrust endwise. Pipe lines buried in earth are put completely out of service.

XII. Panic is general. Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

In 1932, Charles Richter developed a method of measuring the magnitude of an earthquake using seismological instruments. The magnitude assigns a number to the calculated energy release of an earthquake. Because numbers are assigned to the calculated energy release, this system can rank earthquakes and compare them one to another.

The Richter Scale is logarithmic. An increase of one degree in magnitude is equal to 32 times the previous energy release. Thus, an earthquake of magnitude 7 represents about 32 times as much energy release as one of magnitude 6. As shown on the chart, an energy release of 9.0 magnitude is one million times stronger than a 5.0 quake.



SEISMIC INVESTIGATION OF THE RIPON AREA

Faults and Epicenters:

The faults located within San Joaquin County include the Tracy-Stockton fault, the Patterson Pass fault, and the Tesla-Black Butte fault. The Tracy-Stockton fault passes beneath the center of the county in a northeasterly direction. This fault has not been mapped at the surface because of an overlying blanket of geologically young alluvial materials. The inactivity of this fault is open to question, and is discussed below.

Outside the county are a number of faults which are definitely known to be active. The San Andreas system is the most widely known. This system comprises several individually named fault zones in the San Francisco Bay area, the principal ones being the San Andreas, Hayward, and Calaveras. The Green Valley is also part of this system. In addition, there is the Midland fault which is believed to be the source of a major historic earthquake.

1. San Andreas Fault Zone

The San Andreas Fault is one of the longest, best studied, and most active in the world. Some of its segments in the Central Coast Ranges to the south of San Joaquin County are "creeping" at rates as great as 3.5 centimeters per year. Along other segments of the fault, both south and north of the zones where creep is being observed, there is essentially no movement; the fault appears to be temporarily "locked." It is generally agreed that such a locked condition allows regional strain to accumulate more rapidly, thus shortening the time between major earthquakes. It is for this reason that the San Andreas Fault is considered to be extremely dangerous along the segment north of San Juan Bautista.

Throughout the documented history of this fault zone, movement has been primarily in a right-lateral sense. It is possible to reasonably demonstrate an accumulated offset measured in hundreds of miles, occurring over a period of tens of millions of years, along the San Andreas Fault. Since there is presently movement along some of its length, and numerous smaller earthquakes recorded emanating from the fault zone, it is practically a certainty that moderate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SCALE: 1" EQUALS APPROX. 12 MILES
SACRAMENTO
FAIRFIELD
RIO VISTA
GREEN VALLEY FAULT
EARTHQUAKE FAULT MAP
VISIBLE FAULT
FAULT LOCATION APPROXIMATED
BURIED FAULT
SURFACE DISPLACEMENT WITHIN LAST 200 YEARS
SURFACE DISPLACEMENT WITHIN RECENT GEOLOGIC TIME

to great earthquakes will occur on the San Andreas system in the forseeable future.

2. Hayward Fault

The Hayward Fault is located east of San Francisco Bay, and extends southeastward toward Hollister. It probably merges with the Calaveras Fault somewhere north of Hollister. Precise mapping of this junction is difficult because of the cover of recent alluvial sediments in the Santa Clara Valley. A review of the recent history of this fault shows two major earthquakes (1836 and 1868), each with an estimated Richter Magnitude of 7 $\pm$ 0.5. Current measurements indicate active creeping at rates up to 1.0 centimeter per year in places. Numerous small earthquakes of Richter Magnitude of 3 to 5 have occurred along this fault in recent years, indicating continued activity.

3. Calaveras Fault

The Calaveras Fault borders the eastern flank of the Berkeley-Hayward Hills, and extends southeastward until it joins the San Andreas Fault Zone below Hollister. Epicenters of recent earthquakes with Richter Magnitude up to about 4.5 have been located along, or near, this fault. In 1861 an earthquake of unknown magnitude caused ground breakage in the vicinity of Danville. Several centimeters of creep have been measured in the City of Hollister, where the Calaveras Fault trace cuts through a residential area. The pattern of offset curbs, sidewalks, and other man-made structures is similar to that of creep and faulting along other branches of the San Andreas. The Pleasanton Fault, an eastern branch of the Calaveras, also exhibits creep movement. However, it has no record of earthquakes of any significant magnitude.

4. Green Valley-Concord Faults

This fault zone, extending from Walnut Creek to west of Fairfield, has experienced displacement within recent geologic time throughout most of its length. Along part of the fault near Concord an earthquake of 5.4 magnitude occurred in 1955. Maximum probable earthquake magnitude generated by this fault is not expected to exceed 7.0.

5. Midland Fault

This fault zone is buried under recent alluvium. It extends from Bethel Island in the Delta to east of Lake Berryessa. Its activity is more questionable than activity of the faults previously discussed. However, there is evidence south of Rio Vista that fault displacement has occurred during recent geologic time. Also, the State Division of Mines and Geology believes this fault is the possible source of a major earthquake, one centered near Vacaville in 1892. Because of these factors, and the nearness of the fault to Ripon, it cannot be disregarded. Maximum probable earthquake generated by this fault is 7.0.

6. Tracy-Stockton Fault

The Tracy-Stockton Fault passes from near Tracy to directly beneath (and beyond) Stockton in a northeasterly direction. Its position is known only from oil well-log data; no surface expression of this fault has been mapped. Subsurface data indicate that no appreciable movement has occurred on the Tracy-Stockton Fault since Mid-Pliocene time, perhaps five million years ago or more. Ordinarily such evidence would lead to the conclusion that this fault is inactive and therefore does not pose an earthquake threat. However, the easternmost subsurface positions of the Tracy-Stockton Fault raises a serious question as to the inactivity of this fault. On April 10, 1881, an earthquake occurred in this area having an estimated Modified Mercalli Intensity of VII. Although direct correlations between earthquake effects (damage, personal reaction, etc.) and Richter Magnitude are not precise, it seems likely that this earthquake was of approximate Magnitude 5 $\pm$. Two other earthquakes of smaller size (Magnitude 4), occurred approximately 5 miles southeast of Linden on September 19 and 20, 1940. The latter of these epicenters was instrumentally located, but only in a "rough" manner. It is not certain, therefore, as to whether or not these epicenters lie along the northeast extension of the Tracy-Stockton Fault. For purposes of this report, precise location of the fault causing these earthquakes is academic. What is important is that there is an active fault capable of generating at least Magnitude 5 earthquakes located within, or near, the central part of San Joaquin County.

7. Patterson Pass Fault

The Patterson Pass Fault trends northwestward from the San Joaquin-Alameda County boundary toward the Altamont and Livermore. Its location is imprecise and the nature of movement on it, if any, is uncertain. This fault is cited here because of one well-located epicenter with a Magnitude of 4.5 in 1946. It seems unlikely that this small fault presents a significant seismic threat to San Joaquin County in comparison with the other fault systems.

8. Small Buried Fault

A probable small fault having apparent vertical offset has been located in the southwestern protion of the County by aerial photo analysis. It appears to be buried beneath young sediments. Associated land forms suggest geologically recent activity, although this fault probably is not historically active. Additional field investigation of this suspected fault is warranted.

9. Melones Fault Zone

The Melones and Bear Mountain Zones are located northeast of San Joaquin County in the Sierra foothills. There was an earthquake in 1968 causing a Modified Mercalli Intensity rating of V-VI reported by residents in the vicinity of Sonora. However, in light of the general inactivity of faulting within the western foothills of the Sierra Nevada Range, the distance of this region from San Joaquin County, and the infrequency of historic earthquakes on the Melones and Bear Mountain Fault Zones, they are not judged to pose a seismic threat to the County.

10. Tesla and Black Butte Faults

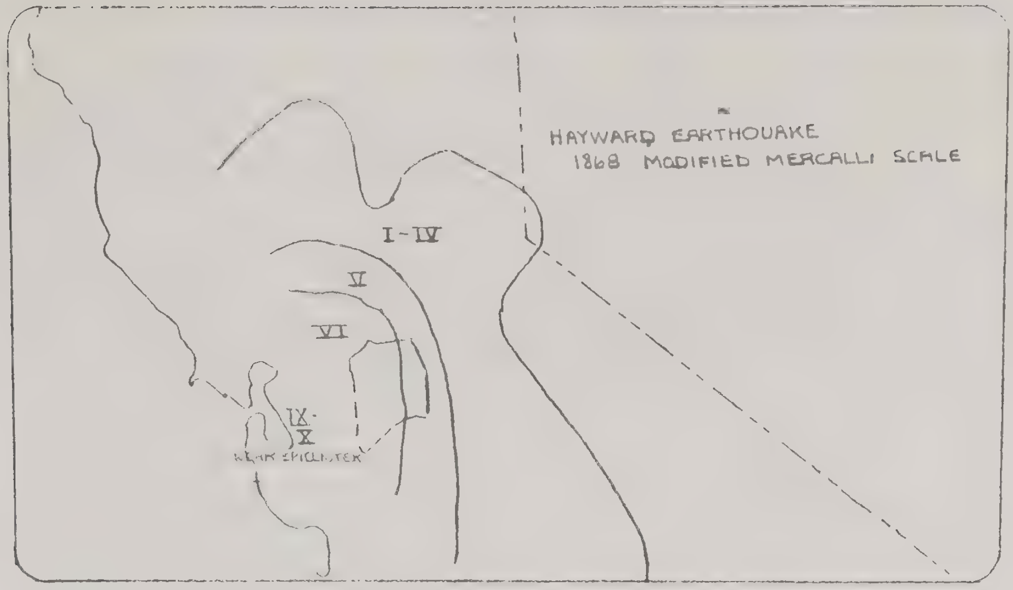
These faults are located in the extreme southwest corner of San Joaquin County. There is no recorded evidence of any activity along either of these faults.

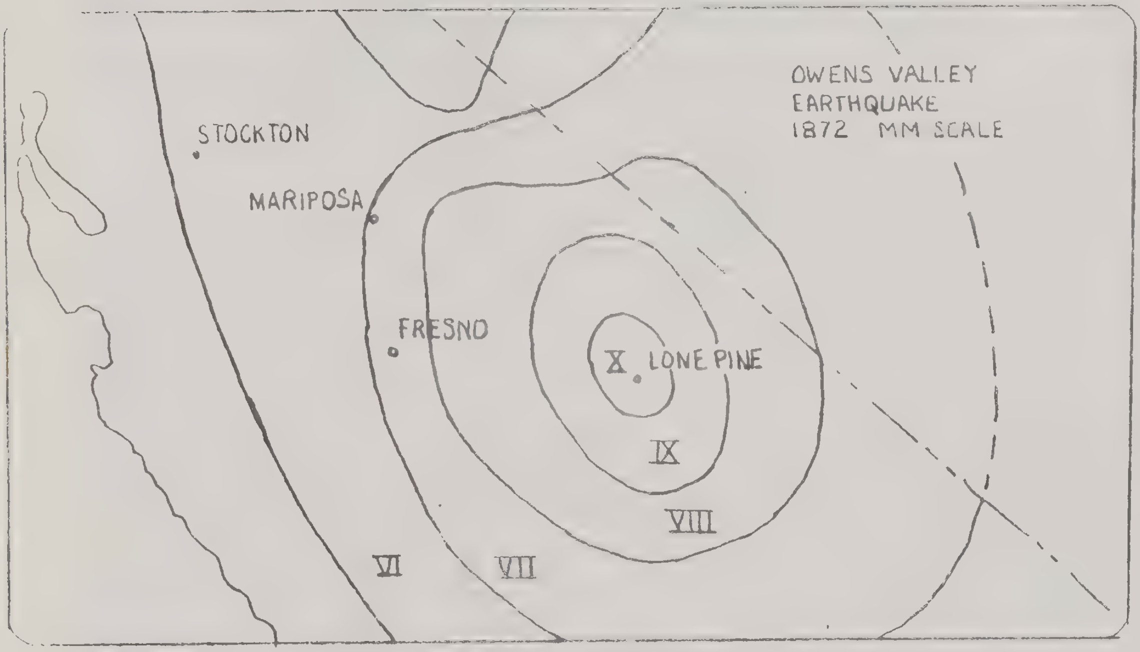
Earthquake History:

The Ripon area has experienced several earthquakes within the last 150 years of intensity V or greater on the Modified Mercalli Scale. The following table lists them:

Date	MM Intensity in Ripon	MM Intensity near Epicenter	Epicenter	Richter Magnitude at Epicenter
1836	V-VI	IX-X	Hayward	7+
1838	VI	X	S.F. Peninsula	7+
1857	VI	X-XI	Mountains between Santa Barbara & Bakersfield	8+
1868	V-VI	IX-X	Hayward	7+
1872	VI	X	Owens Valley	8+
1881	V-VI (?)	VII	Linden	5+
1892	IV-V	VIII	Vacaville	approx. 7
1906	VI-VII	XI	San Francisco	8.3
1940	?	?	Southeast of Linden	4.0
1946	?	?	Patterson Pass	4.5
1952	V	VIII	Bakersfield	approx 7.7
1966	IV-V	VII	North of Tahoe	approx 6.5

The isoseismal maps on the following two pages show lines of equal earthquake intensity plotted for some of the above earth-quakes.





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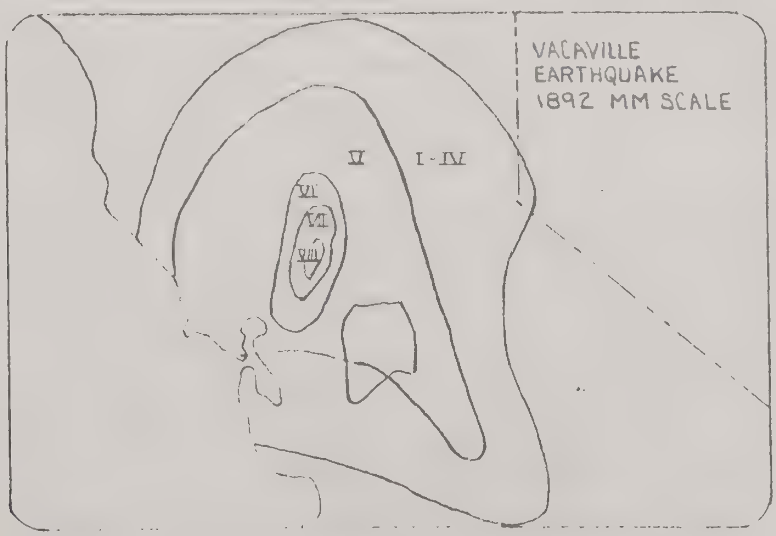

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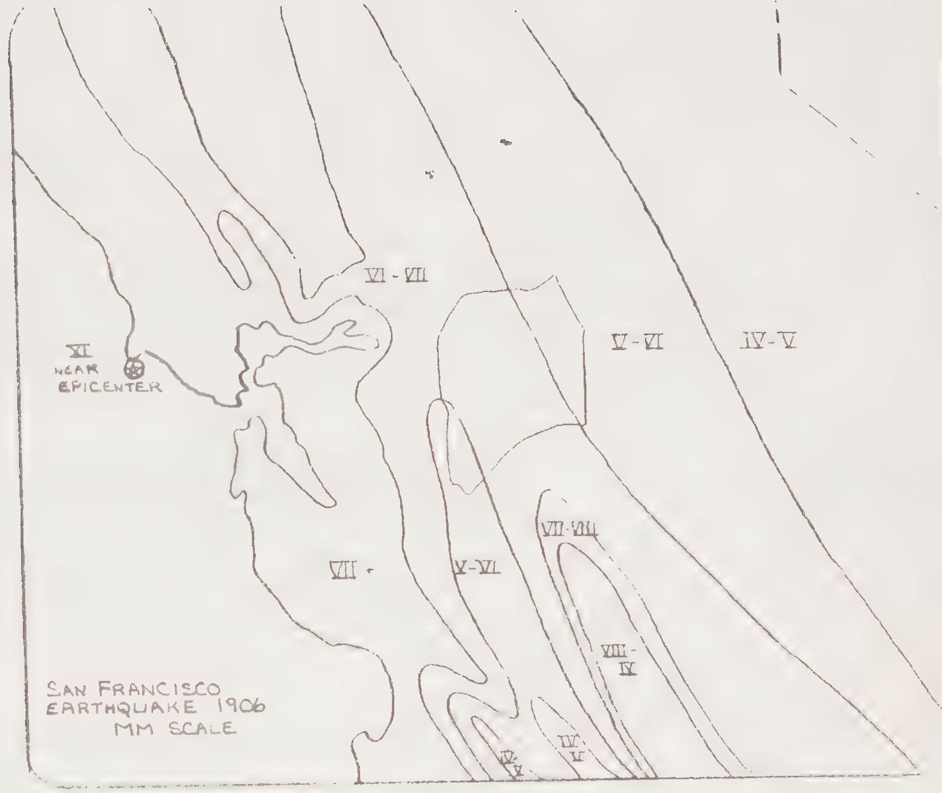
VI - VII
V - VI
IV - V
XI
NEAR
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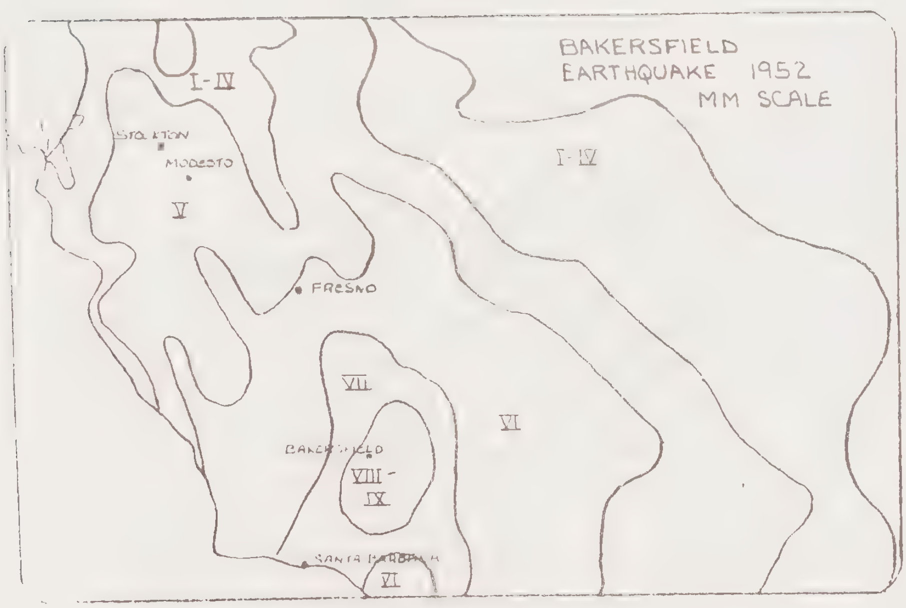
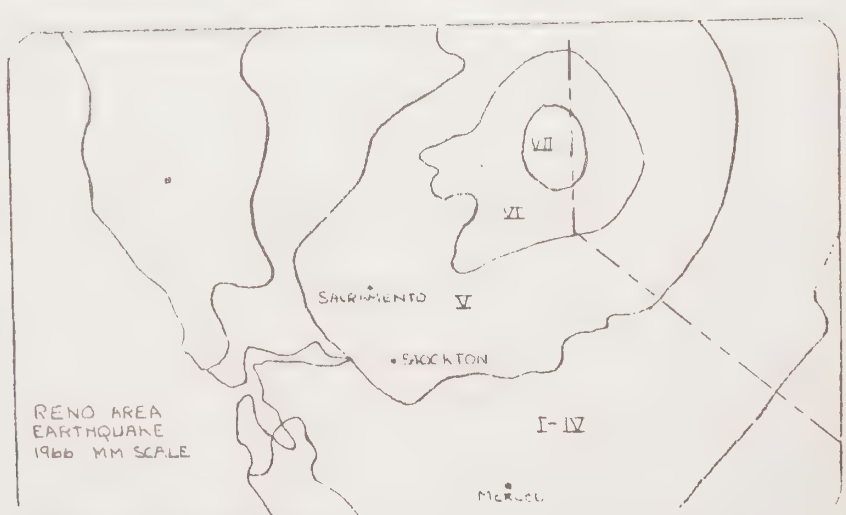
VII +
V - VI
VII - VIII
VIII -
IX
SAN FRANCISCO
EARTHQUAKE 1906
MM SCALE


BAKERSFIELD
EARTHQUAKE 1952
MM SCALE
I - IV
I - IV
MODESTO
V
FRESNO
VII
VI
VIII -
IX
VI


VII
VI
SACRAMENTO
V
STOCKTON
RENO AREA
EARTHQUAKE
1966 MM SCALE
I - IV

Area Seismicity and Ground Shaking

In Ripon, strong ground shaking is of much greater significance than the possibility of local ground rupture which usually occurs along a fault. As before mentioned, the most probable sources of strong ground shaking are the Calaveras, Midland, San Andreas, Hayward, and Tracy-Stockton faults. The intensity of this ground shaking is basically a function of the earthquake magnitude, distance from the epicenter, and soil and rock conditions along the path of the earthquake waves. With these factors in mind, soils engineers and geologists believe that an earthquake of intensity VIII to IX on the Modified Mercalli scale is the "maximum credible" earthquake which could occur in the Ripon area.

The following table summarizes the above information. This table also describes "rocklike material" acceleration. The highest expected period of "rock" acceleration, .13g, is on the low side. (Parts of Los Angeleles and San Francisco, by comparison, can expect rock acceleration up to 5g or greater.) However, earthquake acceleration in rocklike materials is modified by overlying soil conditions. Where the "rock" is overlain by deep, soft soils as it probably is in Ripon, ground surface acceleration or shaking will be greater. (Slower vibrations but larger amplitude). How much greater depends upon how loosely compacted the soil is, how stiff the soil is, how long the shaking lasts, and other factors.

From scattered oil and water well data and general valley geology, it is likely that the depth of soil overlying "rock like" material in Ripon is 500 feet or more. The soils are recently deposited alluvium consisting of unconsolidated, loosely compacted gravel, sand, silt, and clay. Thus they are generally "soft" soils. In some areas, clay hardpan layers "stiffen" the soils making them less "soft".

From this information, the Ripon area can most probably expect slower but larger ground surface vibrations rather than short, fast vibrations during an earthquake. Such long period motions affect tall buildings or structures (over 3-4 stories high) the most severely. Short structures will be less affected.

The Tracy-Stockton fault, because of its proximity to Ripon, is the only fault which might be likely to generate short, more rapid ground shaking in an earthquake.

SEISMIC TABLE REFERENCED TO RIPON

Source of Earthquake	Closest Distance (miles to Causitive Fault	Maximum Credible Earthquake Magnitude occurring at Epicenter	Predominant Period of Rock* Acceleration (Ground surface Acceleration will differ depending upon subsurface ground conditions)	Duration of strong shaking	Estimated Recurrence of Maximum Credible Event	Fault Activity Rating	Maximum Credible Earthquake Intensity which could occur in Ripon (MM Scale)
Calaveras Fault	42	7.5	.13	37 seconds	Unknown	1,2,3	VIII or IX
Midland F.	31	7.0	.13	30 sec.	Unknown	5	VIII or IX
Tracy-Stockton F.	15	5+	.11	30 sec.	Unknown	6	IX
Hayward F.	47	7.5	.11	24 sec.	Unknown	1,2,3	VIII or IX
San Andreas	61	8.3	.11	24 sec.	102 years	1	VIII or IX
Green Valley	48	7.0	.07	less than 18	Unknown	4	VIII or IX

*Rock: Any material with a shear wave greater than 2000 feet/second

Fault Activity Ratings:

1-4: Strong evidence of a relatively high degree of activity. 1: Surface rupture during a historic earthquake; 2: Presently occurring creep; 3: Alignment of earthquake epicenters; 4: Recent Geologic surface displacement but no historic records

5: Possible source of a major historic earthquake

6: Possible source of small historic earthquakes

Sources: Greensfelder, Roger, "Maximum Credible Rock Acceleration from Earthquake in California" Division of Mines and Geology, Sacramento, 1974, and Wallace, R.E. Geological Society of America Bulletin Volume 81, Page 2875, 1970.

Secondary Hazards

Slope Stability:

Slope stability problems in the Ripon area are primarily confined to steep banks along the Stanislaus River. Where the river has undercut or oversteepened the banks, local unstable conditions are created. These steep banks (in an earthquake or otherwise) will eventually flatten out their slope angle by normal slope failures until they reach a condition of equilibrium.

Settlement and Subsidence:

Settlement may occur in poorly consolidated soils during earthquake shaking as a result of a more efficient rearrangement of the individual grains. When it occurs over a large area it is termed subsidence.

The most likely areas in which settlement or subsidence might occur are those in which the soils are loose to medium dense. Improperly founded or poorly compacted fills are quite susceptible to settlement. Also, liquefaction may cause settlement of saturated soils.

Liquefaction:

Seismic soil liquefaction occurs when loose or medium dense water saturated cohesionless soil temporarily loses its strength when subjected to ground shaking. It generally occurs with intense and prolonged ground shaking. As the material tends to compact, the water pressure in the soil increases, and it may reach the point where it becomes equal to the overburden pressure. At this point, the soil loses its strength and liquefies. If the liquefying layer occurs on or near the surface, the soil will act like quicksand. If the liquefying layer is a few feet below the surface, it may provide a sliding surface for the ground above it causing landsliding.

Generally, liquefaction occurs in areas where the groundwater is shallow, as it is in Ripon, and the soils are predominantly clean sands of loose to medium density. The soil along the Stanislaus River would be particularly susceptible while the alluvium in and around Ripon itself would tend to be moderately susceptible to liquefaction.

When liquefaction occurs, buildings may sink or tilt, and lighter materials such as sanitary treatment tanks, and water and gas lines may rise to the surface.

The likelihood of liquefaction actually occurring in areas susceptible to it depends upon the type, intensity and duration of earthquake motion. The looser the soil, the shorter the duration and the less intense the shaking needed to cause liquefaction. More dense soils will withstand longer durations of shaking and more intense shaking before liquefaction occurs.

It is concluded that the Ripon area has moderate potential for

liquefaction during strong earthquake motion. The probability of this actually taking place is considered to be relatively small because of the distance from the major fault zones, and the relative inactivity of the Tracy-Stockton Fault. However, the possibility of soil liquefaction should be considered when planning and designing structures. It should be handled on a site by site basis by a licensed soils engineer. This is particularly important in the design of key facilities.

Tsunamis:

Tsunamis, or tidal wave hazard to Ripon is negligible. Tsunami waves originating in the Pacific Ocean would be dissipated by the expanse of San Francisco Bay.

Seiches

Seiches are periodic oscillations of water level in basins. They can be likened to the oscillations produced by the sloshing of water in a bowl or bucket when it is shaken or jarred. The time of occurrence ranges from a few minutes to a few hours, depending upon the size and shape of the water basin. Amplitude ranges from a few inches to several feet. Generally, they are less than a foot high.

Seiches can occur in reservoirs, rivers, and other bodies of water including water tanks. Bulging of steel tanks due to earthquake forces was noted in the 1971 San Fernando earthquake. The following account also indicates seiches occurred in San Joaquin County during the 1906 earthquake:

> "The heavier shocks were undoubtedly from northwest to southeast. This was shown in several ways. Tanks spilt water in both these directions, and the tank noted above fell nearly to the southeast, although its frame ran approximately east and west, and so offered some resistance to free motion to the southeast. In McCloud's Lake, the waves ran northwest-southeast, breaking highest on the bank and bulkhead in the southeast corner, while the north side was little affected. At the city pumping station on Mormon Channel, a similar effect was noted."

Seiches are not usually harmful to man but their effects should be considered in the design of dams, water tanks, canals, etc. Surges,

similar to seiches but greater in amplitude can be devastating if dams and reservoirs are overtopped and large volumes of water are released downstream.

For Ripon, however, the likelihood of flooding from dam overtopping is not great. Elevated water tanks are a somewhat greater danger. The strength of such tanks in an earthquake should be evaluated by a qualified engineer.

Flooding

The only forseeable flooding danger to Ripon seems to be a dam breakage. And the possibility of dam breakage at the Melones or New Melones dams is not great. The Army Corps of Engineers have made extensive seismic investigations of the dam site area. They are also being careful to minimize earthquake-related dangers in construction of the dam. (See Appendix 5)

The main part of the city and surrounding land is high enough above the Stanislaus River to have kept it free of any historic flooding.

Summary of Geologic Hazards

1) Slope instability and flooding along the banks of the Stanislaus River.
2) Flooding of Ripon in the event of a dam breakage upstream.
3) Low-Moderate liquefaction possibilities.
4) Subsidence or settlement possibilities, particularly on improperly founded or poorly compacted fill.

SEISMIC STANDARDS

Seismic understanding has increased greatly in recent years; and since an impetus has been exerted by the 1971 San Fernando Valley earthquake, many changes in both building structural standards and probabilities of seismic risk are being and have been made. The following are some conclusions drawn from the San Fernando quake* regarding building construction. Some of these suggestions have been incorporated into the 1973 Uniform Building Code.

"1. The hazard of non-earthquake-resistive construction was reemphasized by the quake. Old structures, particularly unreinforced masonry bearing wall type with weak mortar, performed poorly. Collapse of skeleton concrete frame buildings with unreinforced hollow tile walls at the Veterans Hospital resulted in the greatest loss of life.

2. A reassessment is needed on some design criteria and construction methods used for bridges, overpasses, buildings and earth dams. Particular attention should be focused on the poor behavior of many one-story industrial and commercial structures. Plywood diaphragms must be studied and tested. Reinforcing and joinery details must be improved.

3. Increased seismic safety of important structures such as hospitals and utilities must be examined.

4. Modern one-story wood frame and stucco dwellings performed reasonably well considering the high ground accelerations and movements. However, reconsideration of code provisions and enforcement is indicated, particularly for two-story construction and masonry chimneys."

From a local standpoint there has been no recorded major earthquake damage in the Ripon area. However, this does not mean that such activity could not take place. The City of Bakersfield was in the same situation prior to the great 1952 earthquake. Definitive locations of the fault in that area were not made until after the earthquake.

*by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration, the Earthquake Engineering Research Institute.

Based on the foregoing, and other knowledge gained from the Bakersfield and Long Beach earthquakes, and extensive studies in Peru, authorities have suggested the maintenance of a minimum Zone 3 classification throughout the State of California. This is shown in the 1973 Uniform Building Code (see map). Previous editions of the Uniform Building Code had extended Zone 2 into parts of California. Earthquake Zone 2 (an area of moderate damage) is equivalent to VII on the Modified Mercalli Scale. Zone 3 corresponds to VIII + on the MM Scale.

Local engineers even before the 1973 Uniform Building Code had been nearly unanimous in their approval of Zone 3 building regulations. Mr. Cullimore, former City of Stockton Director of Building Safety, in a report on Stockton earthquake probabilities, stated that Earthquake Zone 3 regulations provide twice the lateral force resistance of Earthquake Zone 2 requirements. Further, this added protection is not reflected to any appreciable extent in the cost of most construction. In no case, he reported, under normal design procedures, would the cost difference exceed 2% by using Zone 3 rather than Zone 2 requirements. Most heavy structures that follow normal design procedures would have only minor changes in costs that are relative to the use of Zone 3. The State Master Geology Plan concurs with these estimates, stating that the application of improved building codes, if begun in the design stage, typically add only 1-2% to the total cost of the structure.

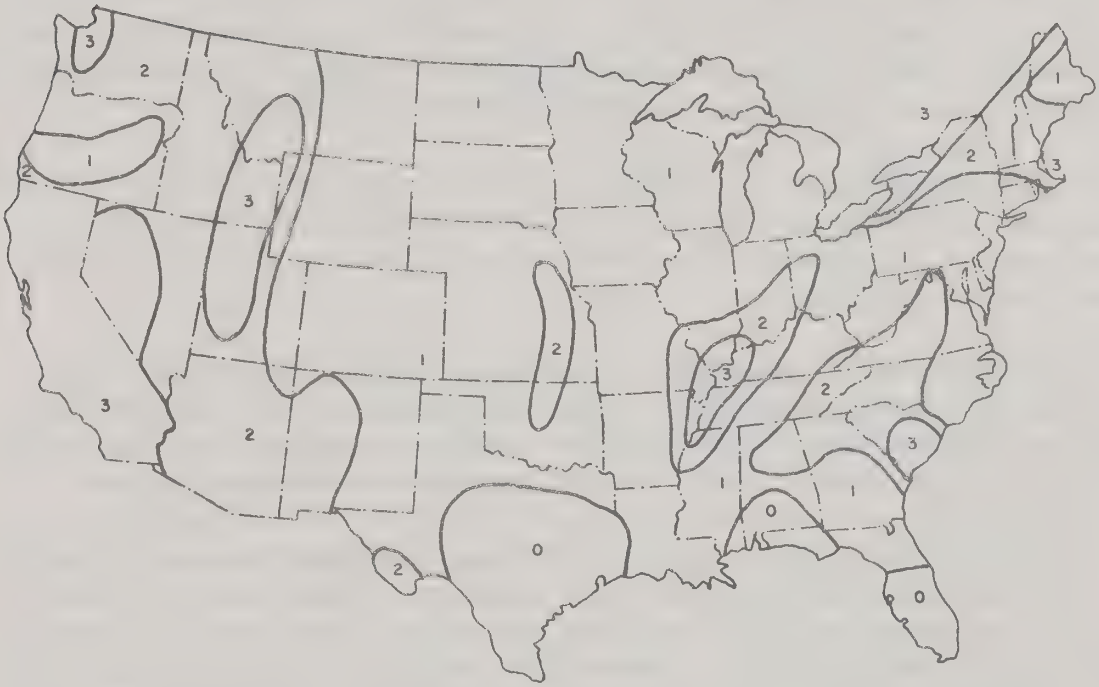
Of course, the Uniform Building Code provides minimum standards and in the case of key facilities, or in critical earthquake damage areas, the costs to make a building highly earthquake safe may cost more.

Earthquake-resistant design and construction of new man-made structures is by far the most effective and practical approach to the problem of preventing or reducing loss of life, injury, and property damage, and disruption of the economy caused by earthquakes.

However, there is also general agreement among seismic safety experts that an urgent need exists for measures to minimize the serious earthquake hazards which exist in many older buildings.

There are some old buildings in Ripon, as there are in almost every city, that are still in use which were designed without calculated earthquake resistance. Most of these were built prior to 1933. Those constructed since that time have various degrees of earthquake resistance built into them. In the 1952

SEISMIC RISK MAP OF THE UNITED STATES



ZONE 0 - No damage

ZONE 1 - Minor damage distant earthquakes may cause damage to structures with fundamental periods greater than 10 seconds corresponds to intensities V and VI of the MM* Scale

ZONE 2 - Moderate damage corresponds to intensity VII of the MM* Scale

ZONE 3 - Major damage corresponds to intensity VIII and higher of the MM* Scale

*Modified Mercalli Intensity Scale of 1931

SOURCE: 1973 UNIFORM BUILDING CODE

Bakersfield quake, post-1933 structures held up fairly well, while pre-1933 buildings were badly damaged.

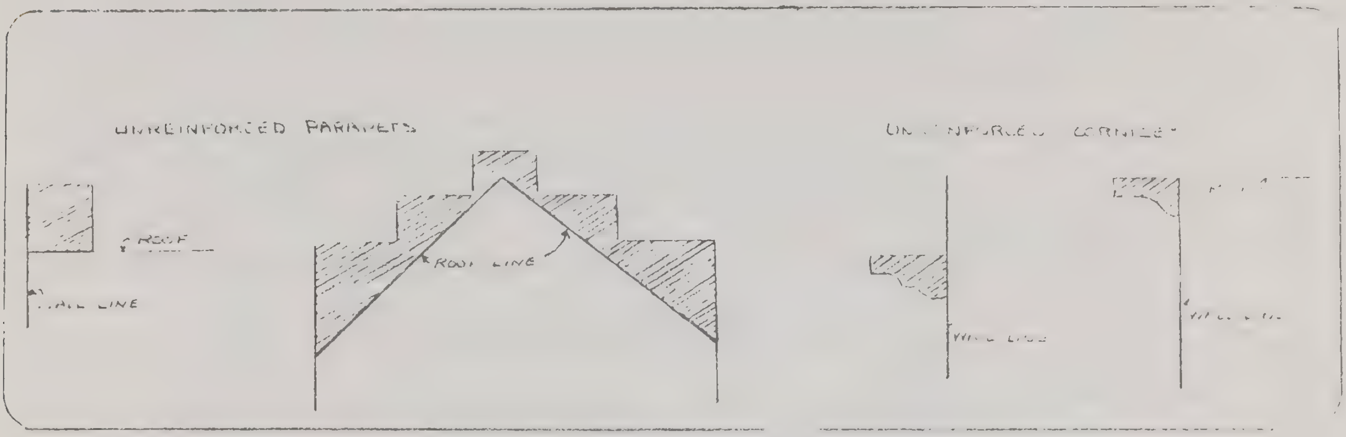
With the establishment of new seismic requirements for building design and construction, the question of the earthquake resistant capabilities of existing buildings arises and how far a government should go to reduce existing hazards. This is a question which must be dealt with locally. In the 1973 UBC, Section 203 deals with "dangerous buildings" and allows local government to declare such buildings a public nuisance and abate them. Some communities have appointed knowledgable committees to make the decisions in such cases.

Although abatement is a wise policy, many cities have avoided this option because of the economic consequences, and concentrated on reducing the hazard of older buildings rather than removing them.

In an earthquake, the most hazardous parts of a building generally are unreinforced masonry units. The following excerpt from a Bay Area Seismic Safety Element explains how such building parts have fared in previous earthquakes.

> "Parapets and Chimneys. Probably the greatest loss of life from earthquakes has resulted from the failure of unreinforced unit masonry, particularly unreinforced brick parapets on commercial buildings. Persons on the streets or inside buildings are often injured by such falling masonry. Chimneys can also be a great hazard in houses and small apartments.
>
> Signs and Appendages. Signs, marquees, cornices, canopies and general ornamentation extending out from buildings pose a great potential hazard in earthquakes if not adequately anchored to the building.
>
> Facades. Two kinds of hazards can be caused by building facades. Masonry veneer facades inadequately anchored, can be shaken loose by an earthquake, causing danger similar to parapets. On the other hand, open glass facades as on stores, can cause amplified twisting to the building and shattering of glass on the sidewalk."

Many cities are requiring reinforcement or removal of parapets, cornices and other ornamentation. The cost is well worth the additional safety gained.



On March 5, 1975, a field survey was conducted to spot some of the structural earthquake hazards in Ripon. The downtown area contained the large majority of buildings built before 1933 (primarily unreinforced brick buildings) and also those buildings with unreinforced architectural ornaments and parapets. A list of hazards which were spotted are contained in Appendix 1.

The table on the following page shows relative safety of various types of buildings in an earthquake. The safest are one-story small wood frame buildings. The most hazardous are unreinforced brick, adobe, hollow concrete block or hollow clay tile.

In conclusion, it is recommended that Ripon adopt the improved earthquake provisions contained in the 1973 Uniform Building Code. This places Ripon in Earthquake Zone 3 as a minimum construction standard. It is also recommended that the City Council adopt an ordinance to reinforce or abate hazardous architectural ornamentation, particularly parapets; and review the problem of unsafe structures.

Hazard Comparison of Non-Earthquake Resistive Buildings

	Simplified Description of Structural Type
Safest	Small wood-frame structures, i.e., dwellings not over 3,000 sq. ft. and not over 3 stories
	Single or multistory steel-frame buildings with concrete exterior walls, concrete floors, and concrete roof. Moderate wall openings
	Single or multistory reinforced-concrete buildings with concrete exterior walls, concrete walls, and concrete roof. Moderate wall openings
	Large area wood-frame buildings and other wood frame buildings
	Single or multistory steel frame buildings with reinforced masonry exterior wall panels; concrete floors and concrete roof
	Single or multistory reinforced-concrete frame buildings with unreinforced masonry exterior wall panels, concrete floors and concrete roof
	Reinforced concrete bearing walls with supported floors and roof of any material (usually wood)
	Buildings with unreinforced brick masonry having sand-lime mortar; and with supported floors and roof of any material (usually wood)
Most Dangerous	Bearing walls of unreinforced adobe, unreinforced hollow concrete block, or unreinforced hollow clay tile

(Table intended for buildings not containing earthquake bracings, and in general, is applicable to most older construction. Unfavorable foundation conditions and/or dangerous roof tanks can increase the earthquake hazard greatly.)

EARTHQUAKE PREPAREDNESS

There are many things a citizen or a community can do to prepare for an earthquake to diminish the effects of an earthquake. This section discusses individual preparedness measures and Ripon's emergency plan in case of earthquakes or other disasters.

Unlike most other natural disasters, such as floods or fires, earthquakes give no warning. It is, therefore, imperative that an individual have a basic understanding of the recommended actions to take prior to, during, and after an earthquake.

A. BEFORE AN EARTHQUAKE

1. Potential earthquake hazards in the home should be removed or corrected. Top-heavy objects and furniture such as bookcases and storage cabinets, should be fastened to the wall and the largest and heaviest objects placed on lower shelves. Water heaters and other appliances should be firmly bolted down, and flexible connections should be used whenever possible.

2. Supplies of food and water, a flashlight, a first aid kit, and a battery-powered radio should be set aside for use in emergencies. Of course, this is advisable for other types of emergencies, as well as for earthquakes.

3. One or more members of the family should have a knowledge of first aid procedures because medical facilities nearly always are overloaded during an emergency or disaster, or may themselves be damaged beyond use.

4. All responsible family members should know what to do to avoid injury and panic. They should know how to turn off the electricity, water and gas; and they should know the locations of the main switch and valves. This is particularly important for teenagers who are likely to be alone with smaller children.

5. Programs that train policemen, firemen, and civil defense wardens how to perform effectively after an earthquake should be supported. One public agency should be designated as being responsible for organizing search-and-rescue activities.

6. Older buildings and public facilities that are not earthquake resistant should be replaced or strengthened.

7. Overhangs, cornices, and parapets on buildings pose an extreme hazard to public safety and should be securely fastened to the buildings or removed.

8. It is most important for a resident of California to be aware that this is "earthquake country" and that earthquakes are most likely to occur again where they have occurred before. Building codes that require earth-quake-resistant construction should be vigorously supported and when enacted into law, should be rigorously enforced.

9. In new construction or in alterations of existing structures, building codes, if they exist, should be diligently followed to reduce and minimize potential hazards. Construction sites should be carefully selected, graded, and engineered to reduce all potential geologic hazards including landslides, subsidence, and the effects of earthquakes.

10. Public safety agencies in your community should have reliable auxiliary communication equipment that can be operated during periods of emergency when regular power supplies may be interrupted.

11. Research to learn more about earthquakes, matching site selection to intended use, and construction of resistant structures should be strongly supported. In the home, at work, or at any other place, you should give some thought to what you would do in the event of an earthquake. Planning ahead may enable you to react effectively during such an emergency.

B. DURING AN EARTHQUAKE

The most important thing to do during an earthquake is to remain calm. If you can do so, you are less likely to be injured. If you are calm, those around you will have a greater tendency to stay calm, too. Make no moves or take no action without thinking about the possible consequences. Motion during an earthquake is not constant; commonly, there are a few seconds between tremors.

1. If you are inside a building, stand in a strong doorway or get under a desk, table, or bed. Watch for falling plaster, bricks, light fixtures, and other objects. Stay away from tall furniture, such as china cabinets, bookcases, and shelves. Stay away from windows, mirrors, and chimneys. In tall buildings, it is best to get under a desk if it is securely fastened to the floor, and to stay away from windows or glass partitions.

2. Do not rush outside. Stairways and exits may be broken or may become jammed with people. Power for elevators and escalators may have failed. Many of the 115 persons who perished in Long Beach and Compton in 1933 ran outside only to be killed by falling debris and collapsing chimneys. If you are in a crowded place such as a theater, athletic stadium, or store, do not rush for an exit because many others will do the same thing. If you must leave a building, choose your exit with care and, when going out, take care to avoid falling debris and collapsing walls or chimneys.

3. If you are outside when an earthquake strikes, try to stay away from high buildings, walls, power poles, lamp posts, or other structures that may fail. Falling or fallen electrical power lines must be avoided. If possible, go to an open area away from all hazards but do not run through the streets. If you are in an automobile, stop in the safest possible place, which, of course, would be an open area, and remain in the car.

C. AFTER AN EARTHQUAKE

1. After an earthquake, the most important thing to do is check for injuries in your family and in the neighborhood. Seriously injured persons should not be moved unless they are in immediate danger of further injury. First aid should be administered, but only by someone who is qualified.

2. Check for fires and fire hazards. If damage has been severe, water lines to hydrants, telephone lines, and fire alarm systems may have been broken; contacting the fire department may be difficult. Some cities, such as San Francisco, have auxiliary water systems and large cisterns in addition to the regular system that supplies water to fire hydrants. Swimming pools, creeks, lakes and fish ponds are possible emergency sources of water for fire fighting.

3. Utility lines to your house--gas, water, and electricity--and appliances should be checked for damage. If there are gas leaks, shut off the main valve which is usually at the gas meter. Do not use matches, lighters, or open-flame appliances until you are sure there are no gas leaks. Do not use electrical switches or appliances if there are gas leaks, because they give off sparks which could ignite the gas. Shut off the electrical power if there is damage to the wiring; the main switch usually is in or next to the main fuse or circuit breaker box. Spilled flammable fluids, medicines, drugs, and other harmful substances should be cleaned up as soon as possible.

4. Water lines may be damaged to such an extent that the water may be off. Emergency drinking water can be obtained from water heaters, toilet tanks, canned fruits and vegetables, and melted ice cubes. Toilets should not be flushed until both the incoming water lines and outgoing sewer lines have been checked to see if they are open. If electrical power is off for any length of time, plan to use the foods in your refrigerator and freezer first before they are spoiled. Canned and dried foods should be saved until last.

5. There may be much shattered glass and other debris in the area, so it is advisable to wear shoes or boots and a hard hat if you own one. Broken glass may get into foods and drinks. Liquids can be either strained through a clean cloth such as a handkerchief or decanted. Fireplaces, portable stoves, or barbecues can be used for emergency cooking but the fireplace chimney should be carefully checked for cracks and other damages before being used. In checking the chimney for damage, it should be approached cautiously, because weakened chimneys may collapse with the slightest of aftershocks. Particular checks should be made of the roof line and in the attic because unnoticed damage can lead to a fire. Closets and other storage areas should be checked for objects that have been dislodged or have fallen, but the doors should be opened carefully because of objects that may have fallen against them.

6. Do not use the telephone unless there is a genuine emergency. Emergencies, and damage reports, alerts, and other information can be obtained by turning on your radio. Do not go sight-seeing; keep the streets open for the passage of emergency

vehicles and equipment. Do not speculate or repeat the speculations of others - this is how rumors start.

7. Stay away from steep landslide-prone areas because aftershocks may trigger a landslide especially if there has been a lot of rain and the ground is nearly saturated. Also stay away from earthquake-damaged structures. Additional earthquake shocks known as "aftershocks" normally occur after the main shock, sometimes over a period of several months. These are usually smaller than the main shock but they can cause damage, too, particularly to damaged and already weakened structures.

8. Parents should stay with young children who may suffer psychological trauma if parents are absent during the occurrence of aftershocks.

9. Cooperate with all public safety and relief organizations. Do not go into damaged areas unless authorized; you are subject to arrest if you get in the way of, or otherwise hinder, rescue operations. Martial law has been declared in a number of earthquake disasters. In the 1906 disaster in San Francisco, several looters were shot.

Emergency Services Plan

The Emergency Services Plan for Ripon was adopted in 1974. It sets up an organizational structure to deal with an emergency and describes emergency tasks to be performed by each designated group or person. It provides for continuity of government. It describes warning signals and communication systems to be used in an emergency. The community center located at Fourth & Locust is designated as a local emergency operating center or shelter.

Four additions could be made to the emergency plan as pre-earthquake preparation.

1. List vulnerable structures in the community as to

   a) how they will endanger public safety and
   b) their effect on emergency operations. For example, part of Main Street may be impassable due to rubble.

2. Establish evacuation routes and alternate evacuation routes, along with procedures for evacuation.

3. Include inundation maps outlining areas subject to flood due to failure of dams. (These will be included in this element when they are completed by the State Office of Emergency Services)

4. Identify and inventory available essential resources for use in an emergency.

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APPENDIX 1

STRUCTURAL HAZARDS SURVEY

Location	Name	Probable Structural Hazard* Unreinforced Parapet	Unreinforced Cornice	Marquee	Other	Probably Unreinforced Brick Bldg.
125 E. Main	IOOF Hall	x	x	x		x
111 E. Main		x				
105 E. Main						x
103 E. Main	Western Auto		x over door			
100 N. Stktn	Wash-Dry	x				
131 N. Stktn	Swier Tire	x				
100 W. Main						x
104 W. Main			x			
103-115 W. Main	Baron's TV Dee & Arlenes Interiors				x brick front looks as if it will "peel off"	x
121 W. Main	Swier Tires		x	x		
129 W. Main	Post Office					x but new brick front
130 W. Main		x				
	Hotel Howard		x (at top)			x
204 W. Main	Valley Variety	x	x			
336 W. Main	Schempers Hardware	x				
Main & Acacia	Bethany Covenent Church			x	x arch. ornament sides of bldg.	
2nd & Orange	First Christian Reformed					x steeple, chimney in back
	Ripona Mkt.	x				
301 N.Acacia	Ripon High School					x stack 20-25' high by swim pool

Meyenberg Milk Co.	x	factory stacks, elevated wood water tank	x
Nestles	x	factory stacks & elevated water tank-appear well constructed	

*It is difficult to be entirely sure whether these structures or ornaments are unreinforced but they appear to be. Owners of these buildings should evaluate listed hazards for earthquake safety.

APPENDIX 2

KEY FACILITIES IN RIPON

Name	Reason Why Designated a Key Facility
City Hall	Records, emergency command center
Police Station	Communications center, records
Fire Station	Communications center, fire & ambulance equipment
Schools, Community Center	High occupancy structures, emergency centers
Bethany Home	High occupancy structure, dependent population
Local Health District Bldg.	Emergency health services.
City Sewage Treatment Plant	Protection from water contamination
Electric Substation	Lighting, power
Second St. Overpass, Highway 99, other major routes	Evacuation routes, communication, emergency aid
Churches	High occupancy structures

APPENDIX 3

This appendix contains the generalized soils, geologic, and water depth data available for the Ripon area.

Roberts Island
STOCKTON
Lathrop
McMullin Ranch
MODESTO
MERCED
LOS BANOS
A
A'
B
B'
C
C'
D
E
E'
P-M
Kp
Km
Ec
bc
N
INDEX MAP
0 2 MILES 10
OUTCROP KEY
P-M CONTINENTAL PLIO-MIO
E MARINE EOCENE
Ec CONTINENTAL EOCENE
Km MORENO FM., CRET
Kp PANOCHE FM., CRET
Jf FRANCISCAN FM., CRET &/OR JURASSIC
bc BASEMENT COMPLEX, CRET & OLDER

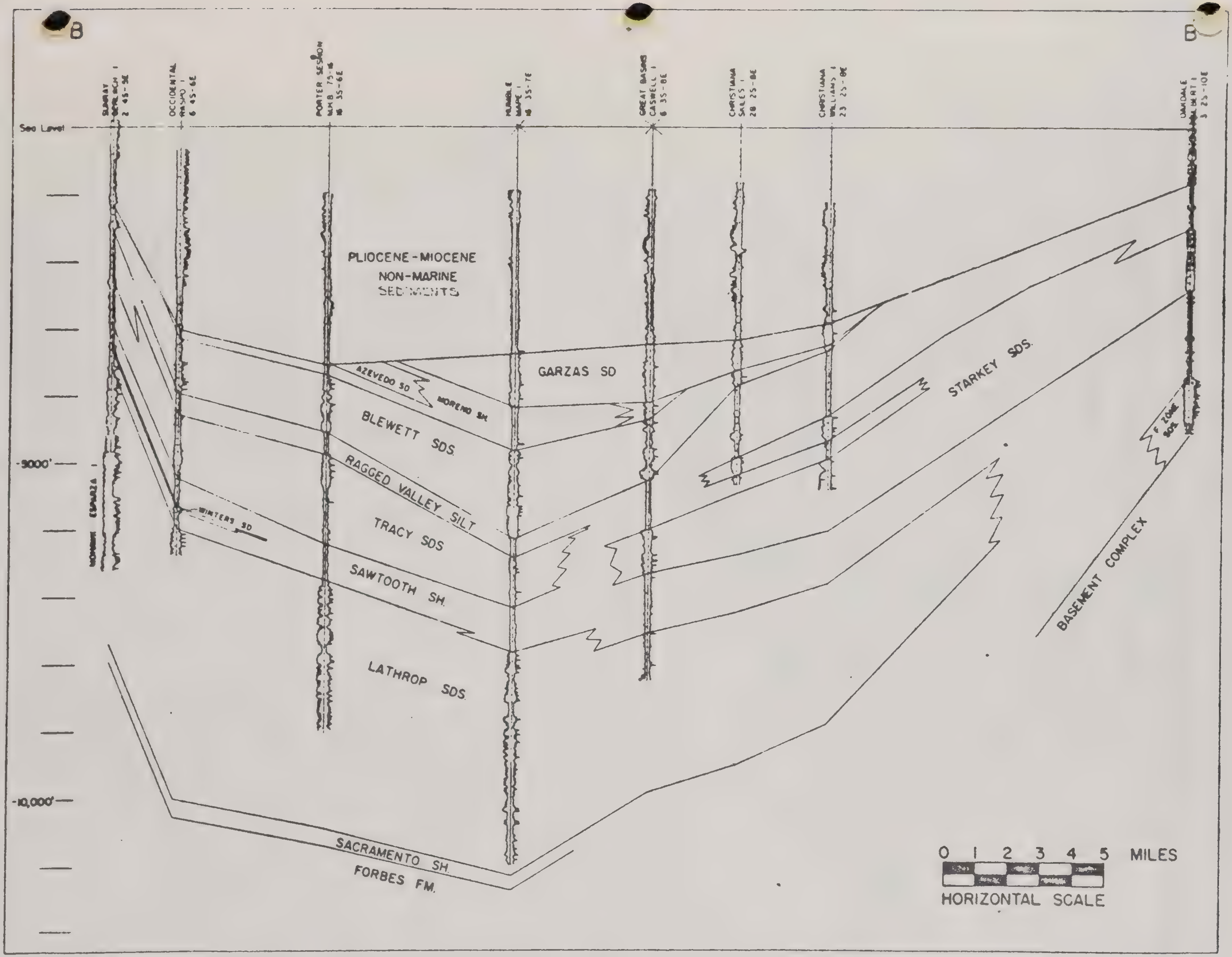
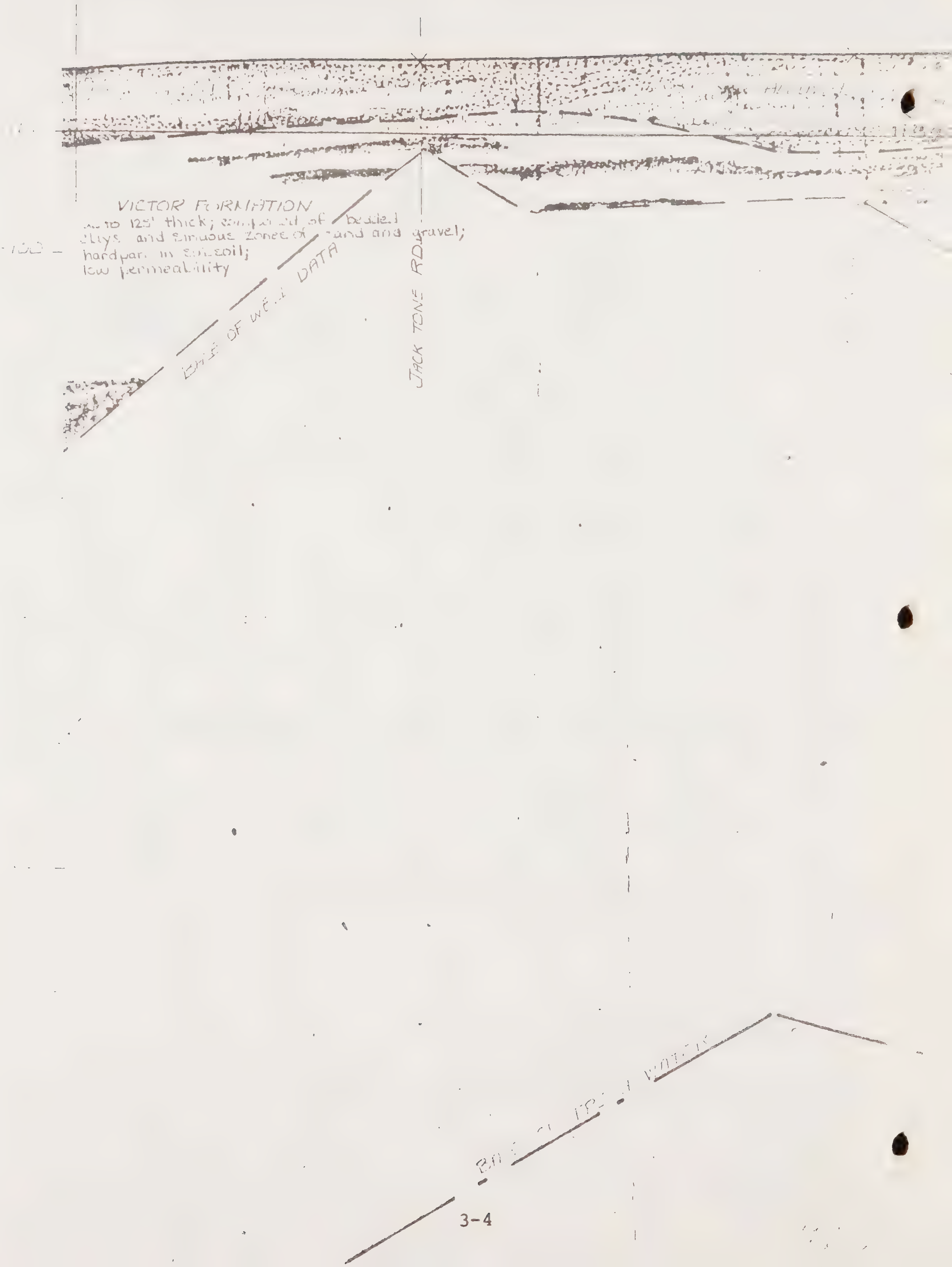
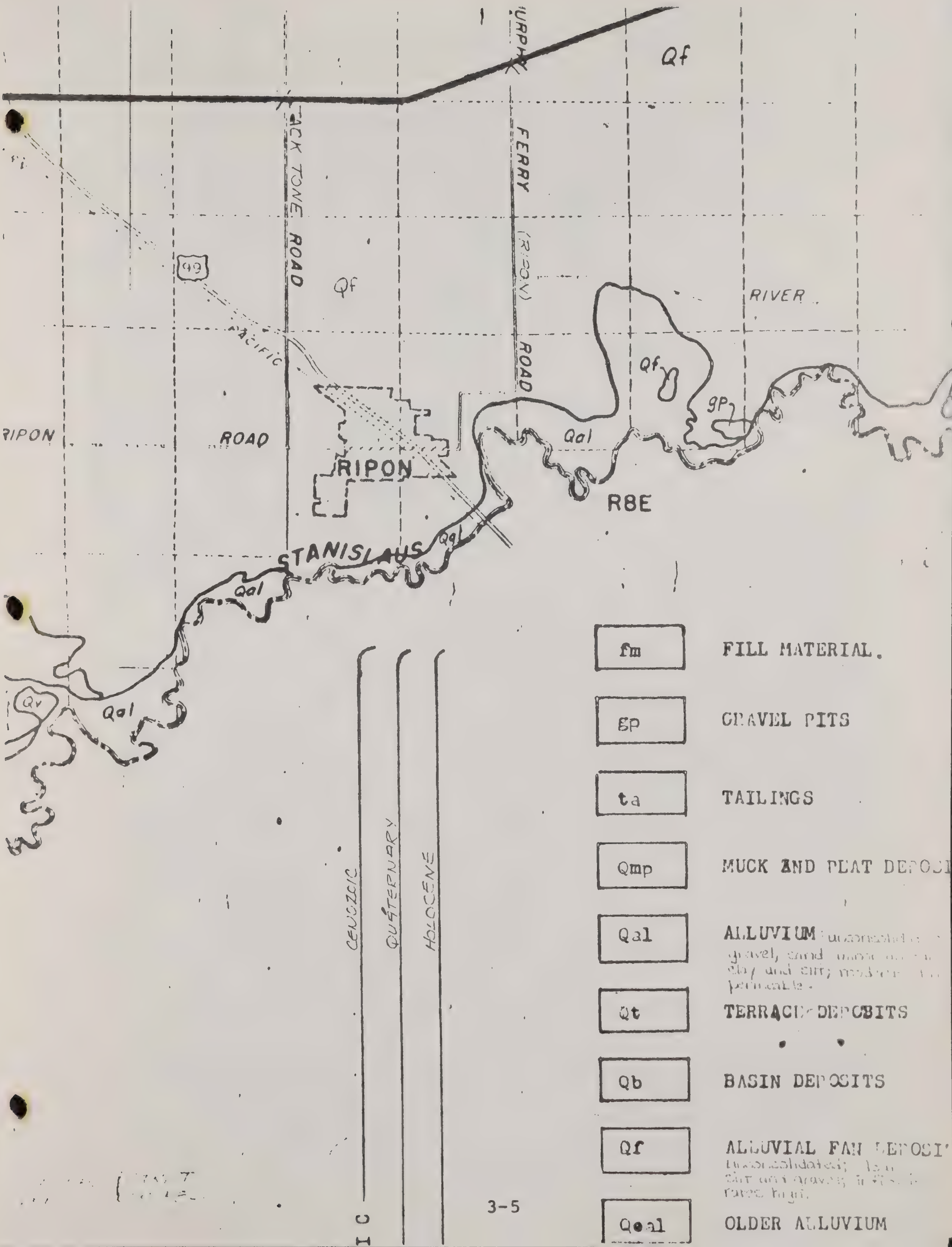
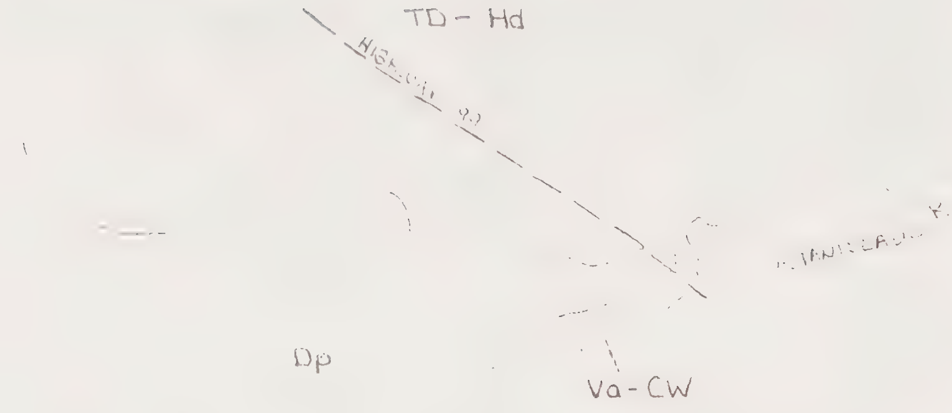


Fig. 3. Correlation section B-B'.


VICTOR FORMATION
and gravel;
low permeability
JACK TONE RD.
DATA


Qf
FERRY
ROAD
(RIPON)
ACK TONE ROAD
99
PACIFIC
RIVER
RIPON
ROAD
RIPON
Qf
gp
Qal
R8E
STANISLAUS
Qal
Qv
CENOZOIC
QUATERNARY
HOLOCENE
fm
FILL MATERIAL.
gp
GRAVEL PITS
ta
TAILINGS
Qmp
MUCK AND PEAT DEPOSI
Qal
ALLUVIUM
Qt
TERRACE DEPOSITS
Qb
BASIN DEPOSITS
Qf
ALLUVIAL FAN DEPOSI
Qoal
OLDER ALLUVIUM

GENERALIZED SOILS
RIPON AREA (SOURCE: [illegible] SERVICE)



TD-Hd: TUJUNGA-HANFORD ASSOCIATION: DEEP TO VERY DEEP SOILS, NEARLY LEVEL TO VERY GENTLY [illegible] ALLUVIAL [illegible]; LOW SHRINK-SWELL; LOW RUNOFF

Dp. DINUBA ASSOCIATION: SAME AS ABOVE EXCEPT [illegible] HIGH [illegible]

Va-CW: COLUMBIA-VALLEZ ASSOCIATION
CW: CLEAR, [illegible]
Va: NOT AS CLEAR, HIGHER DEGREE [illegible]; [illegible] COARSE TEXTURED, [illegible] COMPACTED VERY DEEP [illegible] ALLUVIAL PLAINS

SOILS - RIPON AREA (SOURCE: WEIR)

A1: MEDIUM TEXTURED SOILS HAVING DEEP PERMEABLE SUBSOILS

A5: LIGHT [illegible] SOILS HAVING DEEP PERMEABLE SUBSOILS

A9. MEDIUM TEXTURED [illegible] ON HARDPAN OR HARDPAN-LIKE SUBSTRATUM


SACRAMENTO COUNTY
SAN JOAQUIN COUNTY
AMADOR COUNTY
CALAVERAS COUNTY
STANISLAUS COUNTY
CONTRA COSTA COUNTY
ALAMEDA COUNTY
LODI
STOCKTON
TRACY
SAN JOAQUIN COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
FLOOD CONTROL ENGINEER
LINES OF EQUAL DEPTH
TO WATER IN WELLS
FALL 1974

APPENDIX 4

APPLICABLE STATE LEGISLATION

Public Resources Code

Section 660-662 and 2621-2625: These sections require the State Geologist to delineate special studies zones encompassing potentially and recently active fault traces. It requires cities and counties to exercise specific approval authority with respect to real estate developments or structures for human occupancy within such delineated zones.

Section 2700-2708: These sections require the Division of Mines and Geology to purchase and install strong-motion instruments (to measure the effects of future earthquakes) in representative structures and geologic environments throughout the state.

Education Code

Section 15002.1: This section requires that geological and soils engineering studies be conducted on all new school sites and on existing sites where deemed necessary by the Department of General Services.

Section 15451-15466: These sections constitute the Field Act and require that public schools be designed for the protection of life and property. These sections, enacted in 1933 after the Long Beach earthquake, are enforced by the State Office of Architecture and Construction in accordance with regulations contained in Title 21 of the California Administrative Code.

Health and Safety Code

Sections 15000 et seq.: These sections require that geological and engineering studies be conducted on each new hospital or additions affecting the structure of an existing hospital, excepting therefrom one story Type V buildings 4000 sq. ft. or less in area.

Sections 19100-191500: These sections constitute the Riley Act and require certain buildings to be constructed to resist lateral forces, specified in Title 24 California Administrative Code.

Section 17922, 17951-17958.7: These sections require cities and counties to adopt and enforce the Uniform Building Code, including a grading section (chap. 70), a minimum protection against some geologic hazards.

Business and Professions Code

Section 11010: This section requires that a statement of the soil conditions be prepared and needed modifications be carried out in accordance with the recommendations of a registered civil engineer.

Section 11100-11629: These sections require studies in subdivisions to evaluate the possibilities of flooding and unfavorable soils.

Government Code

Section 8589.5: This section requires that inundation maps and emergency evacuation plans be completed for areas subject to inundation by dam failure.

Section 65300-65302.1: These sections require that each city and county shall adopt the following elements:

- Seismic safety element consisting of the identification and appraisal of seismic hazards including an appraisal of landsliding due to seismic events.
- Safety element including protection of the community from geologic hazards including mapping of known geologic hazards.

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF
SPKED-F

4 April 1975

Ms. Jean Freitas, Planner
San Joaquin County
Council of Governments
1850 East Hazelton Avenue
Stockton, CA 95205

RECEIVED
APR 7 197?
SAN JOAQUIN COUNTY
COUNCIL OF GOVERNMENTS

Dear Ms. Freitas:

In answer to your letter requesting information on the potential dangers resulting from the construction of New Melones Dam, let me assure you that the damsite and reservoir areas have been thoroughly studied with respect to the hazards you are concerned with. To answer your specific questions, the Corps of Engineers has made an extensive investigation of the reservoir area and surrounding hills, and the only potentially dangerous landslides that could cause an overtopping of the dam are being eliminated by excavation. The foundation for the earth and rockfill dam has been explored extensively by drilling and other means and has been found to be a more than adequate foundation. Also, excavation of the abutments that is underway at the present time shows the rock in the foundation to be in good condition without unusual or unforeseen weaknesses.

The Corps has continually developed information on the seismic potential of the Melones fault zone as well as the Bostick Mountain and Bear Mountain faults. Beginning about January 1972, the US Geological Survey, under contract with the Corps, has operated a seismic monitoring network around the New Melones Project. The network consists of nine recording stations in a roughly circular configuration about 12 miles in diameter and centered on the damsite. The original purpose of this instrumentation was simply to measure local seismic events before and after lake filling in order to find out if the reservoir filling had any effect on seismicity. A very practical result applicable to the question of the Mother Lode faults is that we have detected no activity within 50 kilometers (30 miles) of the site. A radius that large includes New Don Pedro Lake, which covers part of the same fault systems as the New Melones Lake will cover. The instruments are quite capable of detecting any seismic activity at New Don Pedro Dam, and frequent chemical blasts from quarrying operations furnish a continual check on network operation. We consider this lack of even microseismic events on the Melones, Bear

Mountain, and Bostick Mountain faults as the first line of "hard" evidence that they are inactive.

Also, we find no evidence in recent work by the US Geological Survey and other agencies that there has been movement in the Mother Lode fault system since the Eocene Period, about 37,000,000 years ago. Our own detailed examination over the past 10 years or more of the Bostick Mountain fault shows that it is very ancient. Some geologists in the US Geological Survey (according to a preprint of unpublished Professional Paper 827), based on recent field work are proposing that these major faults were operative when the rocks were still flat lying in a marine environment. This theory pushes the active period back into the Mesozoic Era, which ended some 65,000,000 years ago. There is just no evidence that the faults in the vicinity of the New Melones project are active in the sense of causing earthquakes in geologically recent times. They are, however, well known features, and we did consider the possibility of lake filling triggering some activity along them. The faults are wide zones of variable rocks and numerous minor faults and shears. These features together with strong jointing in the rocks, lead us to believe that there are no "locked" masses of rock that would snap under lake loading and lubrication. Instead, we believe these rocks will undergo minor slow adjustments that will not generate earthquakes.

Both the foundation for New Melones Dam and the embankment materials have been studied to be certain that they satisfy our seismic stability standards. All streambed materials, which might be subject to liquefaction, will be removed as well as soil and weathered rock on the abutments, and the dam will be constructed on a rock foundation. The rock and clay materials used to construct the dam will not be subject to liquefaction when compacted to the prescribed density. Both the dam and its foundation will be stable under all seismic conditions that are expected to occur. Also, the dam and foundation will be instrumented to provide continual data on movements and seepage.

A reservoir map showing the areas that will be inundated by New Melones Lake is inclosed for your information.

We hope the above information will assure you that there is no apparent need for mitigation measures by the City of Ripon to protect itself from possible geologic events that would cause serious flooding from New Melones Lake. However, please do not hesitate to request further assistance should you have any question in this regard.

Sincerely yours,

George C. Weddell

GEORGE C. WEDDELL
Chief, Engineering Division

1 Incl (dupe)
As stated

SAFETY ELEMENT

TABLE OF CONTENTS

GENERAL POLICY STATEMENT

Government Code Section 65302.1 requires that a safety element accompany all city and county general plans as follows:

> ... for the protection of the community from fires and geologic hazards including features necessary for such protection as evacuation routes, peak load water supply requirements, minimum road widths, clearances around structures, and geologic hazard mapping in areas of known geologic hazard.

The objective of the preparation and adoption of this element is to introduce safety considerations to the active planning process within the planning area in order to reduce loss of life, injuries, damage to property, and economic and social dislocation resulting from flooding, fire, dangerous geologic occurrences, plus other hazards that may affect San Joaquin County.

Based on the interpretation of the intent of the law, the Guidelines issued by the Council of Intergovernmental Relations (1973) define the scope of the Safety Element as including a general policy statement that recognizes safety hazards and which identifies goals for reducing those hazards. The Element should also specify the level of acceptable risk, and discuss voluntary and involuntary risk, in addition to specifying the objectives to be attained in reducing safety hazards as related to existing and new structures. Priorities should be set for the abatement of safety hazards, recognizing the variable frequency and occurrence of hazardous events.

The Safety Element prepared by the San Joaquin County Council of Governments will consider countywide issues: flooding, flood insurance, and flood plain management, building codes and safety, and fire and crime hazard reduction. The particular Safety Element for Ripon has a more narrow range within municipal limits, focusing on the direct application of goals and policies to reduce loss of life, injuries, damage to property, and economic and social dislocation resulting from flooding and fires. Geologic occurrences (including subsidence, erosion, expansive soils and landslides) are covered in the Ripon Seismic Safety Element.

PROBLEMS AND ISSUES

The safety hazards discussed in this element are events that have become hazards only in relation to human adjustment. For example, a flood is a hazard when there is a combination of heavy stream flow and human encroachment upon the flood plain. An earthquake is a hazard when it affects a population area. The relative adequacy of human adjustment is an important concept when talking about people and their adjustment to hazards. The concept represents the relationship between man's demand on nature and his ability to devise a system or a way of serving or coping with those demands. Accordingly, there should be a decline in losses as the adequacy of human adjustment rises; with greater adequacy of adjustment there is increased cost.* It is impossible or uneconomical to eliminate all hazards in a given system, but other choices are available. If the hazard presents a risk that cannot be assumed economically or sociologically, the system must be made tolerant to the hazard. In the past, loss bearing (basically inaction) has been perhaps the most common adjustment practiced by communities exposed to natural hazards. For the future, the savings potential available from the prevention of hazards may offset the cost of necessary system modification.

For a given natural hazard, a wide range of adjustments are possible. Those affected can either try to affect the cause (structural prevention of floods; no way to affect earthquakes); modify the hazard (levee systems, channelization of flood waters; selecting stable soils for building, soil and slope stabilization in case of earthquakes); modify the loss potential (land use changes; warning systems; evacuation; structural modifications); spread the loss (public relief; subsidized insurance); or loss bearing (which affects the individual).

People who have to make an adjustment to a hazard depend on their perception of the hazard, the range of choice open to them, their perception of technology available, the economic viability and efficiency of the alternatives, and their relationships on other people.

Hazard recognition and appraisal is an important component of the Ripon Safety Element.

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*Adjusting to Earthquakes: Costs and Benefits by Tapan Mukerjee, Presented at the Conference on Seismic Risk, California Legislature, Joint Committee on Seismic Safety, Carmel, Sept. 22-27, 1971.

Often, with the advent of a natural disaster, such confusion and chaos has been self-inflicted, resulting from fear, misunderstanding and oversight. Improper design or the construction of buildings in hazardous areas may result in personal injury, structural damage or governmental liability. It is possible, however, with an awareness and understanding of latent risks and costs, plus proper design and protective instruction standards, that future development could make use of potentially hazardous areas.

In conjunction with natural hazards, some mention must be made of man-made hazards. Technological advances have created pressure on the environment where none existed before. The potential for thermal, water and air pollution increased rapidly without a great amount of attention until lately. The hazards of radiation, pesticides and solid wastes threaten not only the environment but man's life style.

- GOAL:

  To reduce adverse economic, social and physical impacts resulting from safety hazards and unacceptable risk of damage.

  It is the policy of the City of Ripon:

  1. To make an accurate "vulnerability analysis" of all hazards so that decision-makers will be able to properly assess the hazards and risks involved in their environment.

  2. To assess hazards in the City of Ripon, and consider adopting programs to reduce unacceptable risks to tolerated risks, and tolerated risks to acceptable risks.

- GOAL:

  To protect the lives and property of the citizens of Ripon from safety hazards and unacceptable risk of damage.

  It is the policy of the City of Ripon:

  1. To increase the citizen's awareness of the hazards and risks involved through educational programs designed to present the alternatives available to adjust to the hazard and the costs and benefits of those alternatives.

  2. To achieve, through the comprehensive planning process, a safe and livable environment.

- GOAL:

  To insure the continuity of vital services and functions.

  It is the policy of the City of Ripon:

  1. To assess the relationship between emergency planning, land use and the population, to assure comprehensive emergency planning.

  2. To maintain an active and experienced emergency organization.

  3. To advise citizens and those with potential responsibilities in a disaster of their duties.

RECOMMENDATIONS

- The goals and intent of the Safety Element should be applied to the other General Plan elements where necessary, and should be reflected in zoning and land division ordinances and pertinent codes, Environmental Impact Reports and Statements, plans for major public improvement projects and implemented throughout the comprehensive planning process.

- A Citizen's Committee should formulate definitions of tolerated and unacceptable risks for the City of Ripon, and see that such definitions are integrated into City policy and planning. (An established group, such as the Safety Council, might serve as the Citizen's Committee.)

- Once the definitions of tolerated and unacceptable risk are defined, and the Citizen's Committee has discussed the possible hazards in Ripon, an educational program should be established to make people aware of possible hazards and risks in the City of Ripon. The City should participate in an on-going safety program.

- The Citizen's Committee should review the "Suggested Guidelines for Fire Protection Criteria for Residential Developments" in order to update the City of Ripon's ordinances and policies dealing with fire protection.

- The City of Ripon should assess possible hazardous structures in the City, and maintain an abatement policy toward hazardous structures.

- Capital improvement programs and projects should be reviewed to coordinate the costs of improvements to levels of risk in the City.

- Flood plain management policies should be implemented along with the City of Ripon's participation in the National Flood Insurance Program.

- The Emergency Services Operational Plan should be expanded, with the necessary annexes added, and kept up to date.

- The Emergency Services Council should be activated, to deal with emergency procedures for Ripon, to maintain close ties with the County Emergency Services Office, and to hold preparatory drills.

- After the inundation maps and evacuation planning measures are presented to the County (in November, 1975), such information and recommendations as are necessary should be added to the Safety Element.

ACCEPTABLE RISK

The concept of "risk" involves both awareness and choice (decision-making). It involves the voluntary taking of a dangerous chance. It also involves the element of probability (the chance that a given event will occur). This presents an interesting dichotomy: if a person is generally unaware of a hazard, such as it is, that individual cannot by definition make a choice, and therefore that person is not voluntarily taking a chance or a risk. Thus, it falls upon the city or county (or jurisdiction involved) to take the responsibility to educate the public as to the risks involved in the surrounding environment.

A city or county or other government cannot reasonably reduce all sources of danger to its citizens - reason precludes the existence of a perfect, hazard-free environment. Natural and man-made hazards of some kind and degree are always present. In addition, the safety considerations of several of the most commonly thought-of hazards--traffic safety, civil defense and dam safety--are preempted by other jurisdictions, with essentially police, fire and building safety left to the cities and counties.

Hazards or risks in many circumstances are generally quantifiable and the costs associated with hazard/risk reduction can be calculated. However, the level of risk which is acceptable to the city--that level at which safety improvements are neither particularly humane nor cost-effective--is difficult to ascertain.

The General Plan Guidelines, issued by the State, define the idea of risk as follows:

acceptable risk: the level of risk below which no specific action by local government is deemed necessary.
unacceptable risk: the level of risk above which specific action is deemed necessary to protect life and property.
avoidable risk: risk that should not be necessary to take because individual or public goals can be achieved at the same or at less total "cost" without taking the risk.

The issue of acceptable risk is then summarized by the Guidelines in stating that the central question is "how safe is safe enough?" But answering the question of "how safe is safe enough?" does not give a meaningful answer to acceptable risk.

Nearly all aspects of life involve some degree of risk. A great deal of individual and collective effort is directed toward minimizing perceived risk. It does not follow, however, that if constraints (i.e., lack of knowledge, limited resources,

conflicting priorities, etc.) limit such efforts that the remaining degree of risk becomes "acceptable." It must certainly be tolerated, but then only until more knowledge is acquired, additional resources generated, or priorities shifted. A defined level of "acceptable risk" simply refers to those risks that, for a number of reasons, cannot or are not being currently reduced.

That level will constantly change and will always hover just beyond our capabilities for risk reduction. The relative nature of an acceptable level of risk renders its definition a questionable guide for public policy.

Rather than trying to ascertain an acceptable level of risk, perhaps efforts should be concentrated on defining risks that the community will not accept, and devising programs for their elimination. Other risks will continue to be tolerated until the time comes that further risk reduction is feasible.

This position is based upon three assumptions: no perceivable risk is acceptable; some risk must always be tolerated; and criteria can be developed to define those risks that cannot be tolerated and are consequently unacceptable.

Therefore, the following definitions are offered as an approach to risk classification:

<u>tolerated risk</u>: perceivable risks to life and property that are not currently being reduced due to technological limitations, limited resources or conflicting priorities. (this definition assigns no characteristics to the nature of such risk and is meant solely to address its status in relationship to current reduction capabilities.)
<u>unacceptable risk</u>: perceivable risks to life and property that must be reduced through ongoing government action programs.*

The most important question to ask is not whether an acceptable level of risk exists but what it is and what do we know about it. Operationally the risks we accept and tolerate now define an acceptable limit.

Recognizing each city's limited resources, the levels of risk should be substantially correlated to the cost of improvements in safety.

There are two ways to view the cost of improvements. The first is to examine the cost associated by not improving existing services in favor of maintaining an existing level of service despite growth and increased safety demands. This type of approach results in a net loss of service. The second method

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* Above definitions were first used in the Los Angeles County Seismic Safety Element.

of upgrading current services is increasing capability to meet safety demands.

The next question then is how much improvement is cost-beneficial. In other words, will potential benefits from service outweigh potential costs for improvement. This type of equation can only accurately figure explicit benefits--for example, lowering fire ratings or percentages of structures saved because of improved capabilities. However, intangible benefits also have to be taken into account. The implicit benefits are very difficult to assess and quantify and are usually controversial--for example, how much is it worth to know that there is adequate ambulance service, or that there is an adequate number of policemen on duty at night.

At some point, the costs for added precautions, in relation to the hazard, outweigh the benefits in relation to other needs. This is the point of acceptability. What is considered acceptable before the occurrence of a hazard, may not be acceptable afterward; as a consequence the point of acceptability may shift over time. The occurrence of such a hazard may result in concensus changes that push the point of acceptability closer to the "safe" end of the spectrum.

Policy and decision makers should try to use the concept of tolerated risk in defining the risks the community will not accept, and devising programs for their elimination. Policy makers should try to ameliorate the many "avoidable risks" which are generally apparent and which may contribute to hazards resulting from carelessness, the lack of attention to safeguards or the failure to conform to existing safety standards. Public information programs will be effective in reducing such risks. Policy should also be directed to reducing unacceptable risks to the "tolerated risk" level, which might be reached to a substantial degree in most of the planning area through consistent enforcement of existing (and new, if needed) codes and regulations pertaining to construction, sanitation, fire zones, land use, land development projects, and urban, rural, and brush fire safety standards, etc. Tolerated risks, or those not currently being reduced, should be reassessed, to consider cost, benefits, and priorities, in order to ensure public safety.

RELATION OF ELEMENT TO PLANNING AREA

The Safety Element is strongly related to natural physical hazards and to careless or accidental hazards promulgated by man. The San Joaquin County area ranges from the Delta to the valley floor to rolling foothills, with many different vegetation types - natural and cultivated. Population and physical improvements are concentrated for the most part in incorporated cities, although some low density suburban areas do exist. Ninety-one percent of the County is in some type of open space use (cultivation, grazing, recreation, open space). With the broad expanse of land comes a broad range of hazards. For example, the San Joaquin Delta will be treated separately in its own section, posing as it does a wide variety of hazards such as soil subsidence, peat fires, and flooding.

For people living in smaller communities or in suburban areas (Woodbridge, Farmington, Linden, Morada, etc), policy and decision makers have to remember that many services either will not be available or will be unuseable in the case of a disaster, thus calling for a different response than if they were in a city. Currently, because of small centers and the spread of population and development, the man-induced hazards are still second, or moderate in relation to those natural disasters which may strike.

RELATIONSHIP OF SAFETY ELEMENT TO OTHER GENERAL PLAN ELEMENTS

Some of the more obvious natural and domestic hazards have been considered in the development of past General Plan elements (for example, flooding in the Conservation Element), in zoning, in building and housing codes and in the review of land development projects, etc.

Now, with the greater awareness of hazards and the possible impact of natural or man-made disasters and with factual information and this General Plan Element available, it is imperative that the goals, policies and recommendations contained within this Element, be applied, as appropriate, to all other General Plan Elements: be reflected in zoning and land division ordinances and pertinent codes, environmental impact statements and reports, plans for major public improvement projects, and generally throughout the comprehensive planning process.

FLOOD HAZARDS

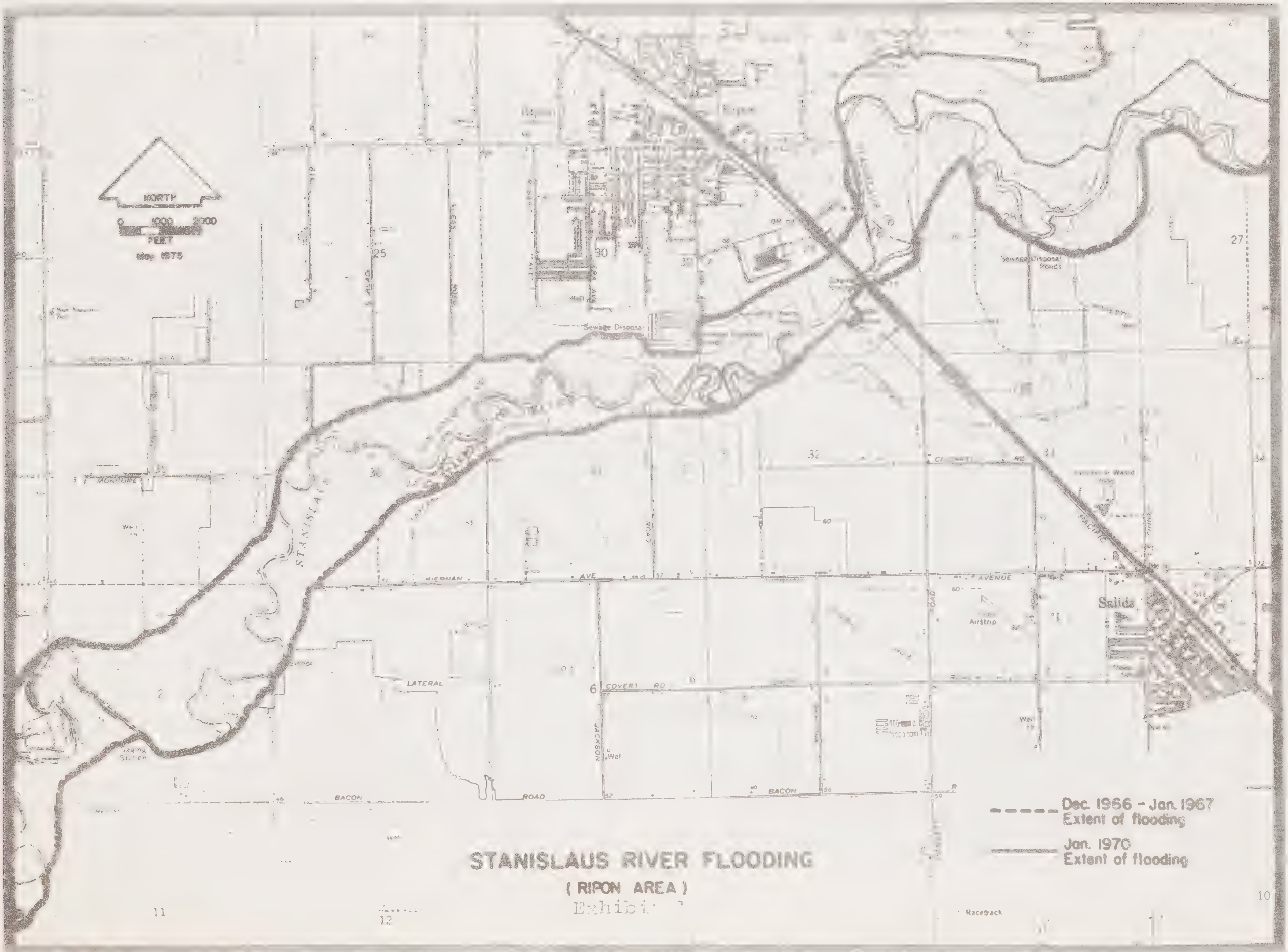
No records were found indicating that the main part of the City of Ripon has been flooded in the past. Ripon is in an area of alluvial fan deposits; however, the City is located above the river's floodplain. It is unlikely that Ripon would experience flooding outside of the present floodplain. Existing and proposed upstream dams and diversions, plus levees and channel retention projects maintain the river channels, insuring little river diversion. However, widespread areas of standing water may occur in the City during long, intense periods of precipitation.

Presently, flood waters would probably extend only to the sewage treatment plant on the south side of the City. (The plant itself is not subject to flooding since structural flood protection has been built into recent additions.) An industrial site (Simpson-Lee) will experience some flooding, especially at the waste ponds, but they are aware of the problem. The map (Exhibit 1) showing the extent of flooding in the 1966-67 flood and 1970 flood illustrates how much of the industrial site flooded and the way flood waters were diverted around the sewage disposal plant. One of these floods was less than a 100-year flood.*

The accompanying chart details the flow of water at cubic feet per second at the highest point during the several floods listed. Although maps are not available showing the extent of these floods, the amount of flow and the maximum water level above sea level should give an indication of the magnitude of flooding. As is explained in Exhibit 2, the flood of January 1970 has been determined as a 100 year flood, which would indicate that the floods of January 1969, December 1955, and probably of February 1933 were greater than 100 year floods, indicating the extent of flooding that would be reached or surpassed again.

In the future, the only flooding that might occur in the City of Ripon would be the result of dam breakage at the Melones or New Melones Dams, according to inundation maps at the Office of Emergency Services. The possibility of such an occurrence is

*Definition of a 100 year flood (or Intermediate Regional Flood): A flood having an average frequency of occurrence on the order of one in a hundred years although it may occur, and has a one percent chance of occurring, in any given year.



STANISLAUS RIVER FLOODING
(RIPON AREA)
Exhibit

Recorded High Water Levels on Stanislaus River at Ripon

Date	Volume of flow in cubic feet/second*	Maximum water level* in feet above sea level**
Jan 1970	15,400 cfs	58.44 feet
Jan 1969	26,800	60.43
Dec. 1964	32,800	62.26
April 1958	14,600	57,48
Dec. 1955	62,500	63.25
Feb. 1938	Unknown	64.54***

It has been determined by the Army Corps of Engineers that the flood levels in January 1970 most nearly approximate a 100 year flood level. This January 1970 flood is marked on the accompanying map. Thus, according to the above chart, those floods measuring over 15,400 cubic feet per second can be assumed to be greater that a 100 year flood (floods in January 1969, December 1964, December 1955 and presumably the February 1938 flood, although this can not be compared at the same level, since all that is available is the high water mark).

* Measured by gauge located at Highway 99 bridge over Stanislaus River.

** According to Water Supply Papers, in Water Resources Data, published by the Geological Survey, Department of the Interior, in June 1971, when the Stanislaus River was flowing at 3400 cubic feet per second, a medium stage, the water level was at approximately 49.5 feet above sea level, to compare to the flood level measurements above. The flow of the River is regulated by power plants and resevoirs upstream, and other diversions.

*** This measurement is a high water mark, rather than an actual gauge measurement, and as such, cannot be equally compared.

Source: State of California Water Records

not great according to the Army Corps of Engineers. They have made extensive seismic investigations of the dam site area of New Melones, and in addition, the dam is constructed in such a way as to minimize earthquake related dangers.

The inundation maps that will detail the amount of flooding should Melones Dam or New Melones Dam break will be available later in the year, and at that time will be added to the Safety Element, with a discussion of evacuation procedures appropriate for Ripon.

NATIONAL FLOOD INSURANCE PROGRAM

The City of Ripon recently declared their intention to enter the National Flood Insurance Program which was established by the National Flood Insurance Act of 1968, and expanded by the Flood Disaster Protection Act of 1973. The program offers limited amounts of flood insurance to property owners at federally subsidized rates, in a cooperative effort by the federal government, private insurance companies and local government.

In recent years, the federal government has spent many billions of dollars to compensate flood victims for property losses. Since 1936, more than $7 billion has been spent to construct flood protection works. However, annual flood losses amount to about $1.25 billion, and are continuing to increase, largely as a result of the improper use of flood plains. This Act is, in effect, an effort to call a halt to the prevalent practice of building indiscriminately in flood hazard areas. This Act also asks the local jurisdiction to inform people living in flood hazard areas about the risks of flooding to which they are exposed, and offers an opportunity for protection from financial loss for people living in those areas.

Participation in the National Flood Insurance Program means that: (1) property owners may purchase flood insurance; (2) the federal government will identify the flood hazard areas; (3) once the official Housing and Urban Development maps are obtained, lending agents will require flood insurance as a condition of any form of federal or federally related financial assistance for acquisition or construction of buildings in the identified special flood hazard areas; (4) once official maps are obtained, damages caused by flooding in identified flood hazard areas will no longer be eligible for government disaster loans; and (5) the city will be establishing building and zoning regulations in the identified special flood hazard areas.

The Flood Disaster Protection Act precludes development of the hundred year floodway as defined by the Act. This floodway is defined as the area designed to carry the waters of a one hundred year flood, without increasing the water surface elevation of that flood more than one foot at any point. No fill or encroachments of any kind are allowed within the designated floodway that would impair its ability to carry the waters of the one hundred year flood. Any new construction or substantial improvements of residential structures within the area of special flood hazards are required to have the lowest floor including the basement elevated to or above the level of the hundred year flood. New construction or substantial improvements of non-residential structures must be elevated above the level of the hundred year flood or be flood-proofed up to the level of the

hundred year flood.

Ripon has received the first of the Housing and Urban Development maps, the Flood Hazard Boundary Map, (see Exhibit 3), which delineates the areas subject to severe flooding. The city officials of Ripon are challenging this map in part, since they feel that the area delineated in the north part of town has been taken care of by a storm drainage system.

A second map, the Flood Insurance Rate Map, is issued to the community after the first map has been established and further information has been gathered. It is the result of a detailed engineering study, and further refines the boundary lines of a community's special flood hazard areas to reflect the flood elevations in such areas that would occur during a flood with a one percent chance of occurrence in any given year. The acturial or non-subsidized premium rates reflecting the degree of flood risk to which properties are exposed in flood-prone areas are determined from this data. This map with its flood elevations can also be appealed. These maps are prepared with existing information gathered from the community; local input is considered a valuable and vital part of the study. Maps such as the preceding one (see Exhibit 1), showing Ripon area flooding in 1966 and 1967 and 1970 would be used to show historical flooding and to determine the probable extent of flooding, even though those floods are of lesser magnitude than the one hundred year flood.

(This map is being challenged by the city officials in Ripon, since the area marked by an asterisk is no longer a hazard area, due to the installation of storm water collection system.)

Flood Hazard Boundary Map
May 1975
(Subject to revision)

Exhibit 3

FIRE HAZARDS*

The Ripon Consolidated Fire District is responsible for both the City of Ripon and the surrounding area as shown in Exhibit 1. The Fire Department is manned by three paid chief officers and 61 volunteer firemen, with two stations, six pumpers, two tankers, and one patrol pumper for brush fires. Eleven of the firemen have special training in rescue and extrication work, to operate the rescue squad. The Ripon Fire Department is also responsible for the ambulance service in Ripon, with 18 volunteer ambulance attendants, for a total manpower of 82. The ambulance is one of the best equipped in San Joaquin County, with a heart-lung resuscitator, an E.C.G. scope and read-out, defibrilator and electronic pulse meters, and blood pressure sphigmastats. The Department operates as a five company department, with four pumper companies and one ambulance company. The special rescue squad is made up of a specialist from each company.

There have been very few recent urban fires as shown in the following compilation from 1969 to 1975:

CITY

	69/70	71/72	74/75[1]
Commercial	0	4	1
Residential	2	2	3
Industrial	0	0	1
Non-Structural	1	12	14
Total Fires	3	23	29
Loss/Property Damage	$983.00	$21,600.00	$4,600.00

RURAL AREA

	69/70	71/72	74/75[1]
Commercial	0	1	0
Residential	4	8	5
Industrial	0	0	1
Non-Structural	17	37	53
Total Fires	21	46	59
Loss/Property Damage	$3,930.00	$46,645.00	$14,750.00

*Source: Chief Van Dyken, Ripon Consolidated Fire Department
1 Total figures for 1975 are not complete yet.

According to the chart, there have been relatively few structural fires. A majority of the fires were grass and brush fires. The City of Ripon reduces grass fire hazards within the city limit through enforcement of weed abatement programs.

Statistics for the ambulances over a one year period of February 28, 1974 to February 28, 1975 are as follows: transported 189 patients, made 9 dry runs for a total of 198 calls; spent 4,341 man hours in training, and spent 769 man hours in actual transporting (including both rural and city calls).

The emergency response time in the City of Ripon on a Code 3 response to any point within the city limits will not exceed three minutes for first-in equipment during day time response. During the hours of 10:00 p.m. to 7:00 a.m. the response may be from two to three minutes longer. This response time is based on a response to an alarm for a fire with volunteer response. The response time for rescue squad with paid personnel should not exceed two minutes from the time of receipt of the call. The primary route through the City of Ripon is Highway 99. The secondary routes through Ripon are West Ripon Road to the west, and North Ripon Road to the north.

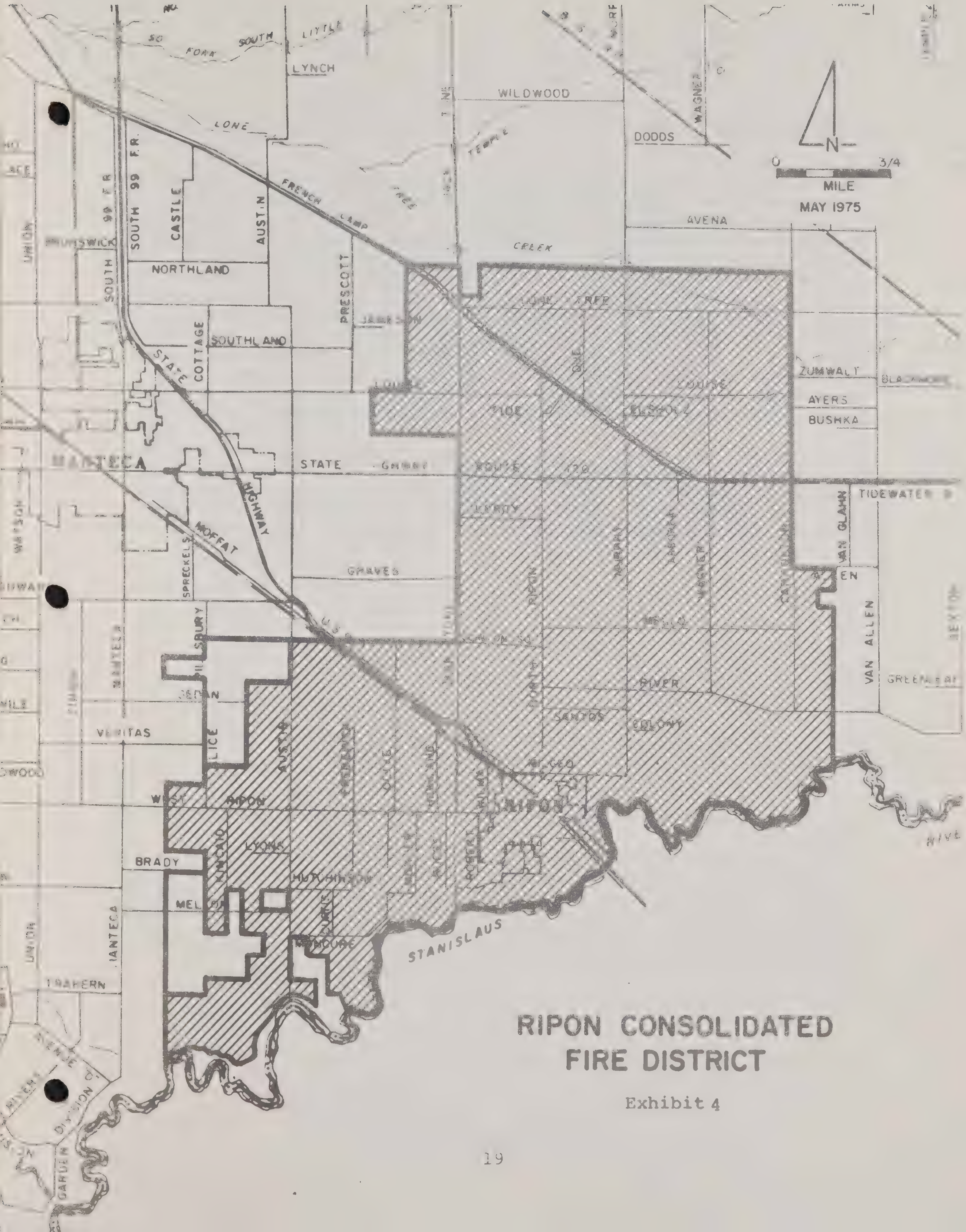
The City of Ripon is presently classified as Class 5 for building insurance purposes by the Fire Insurances Underwriters. The City has upgraded the water system since the last insurance rating with the addition of two wells and pumps with a pumping capacity of 1,500 G.P.M. per well or a total of 3,000 G.P.M. This gives the City a water flow of 5,500 G.P.M. Ripon has also installed larger water mains, and has looped the mains to make a good distribution network. The City also has reciprocal agreement with the Nestles Company for additional water from their wells to supplement the city supply in cases of emergency. This adds 1,000 G.P.M. to the water flow capacity.

Firemen are alerted for an emergency by air horns and sirens; the average one station response is 20 men. The ambulance attendants are set on a rotating schedule with three attendants on call at all times, alerted by monitor radios. The average response time of the ambulance is three minutes from the time of the call. The ambulance is also equipped with the Med-Net radio and can communicate with any Med-Net equipped hospitals in San Joaquin County and Stanislaus County.

Fire prevention and educational programs typically provide increased fire safety awareness in the home as well as in commercial establishments. As resources become available, expanded prevention and educational programs will be initiated.

The City of Ripon maintains an excellent volunteer fire department (with a well-equipped and well-trained ambulance rescue team) with regular and stringent training programs.

The combination of fire prevention techniques and an effective fire suppression contingent provides reasonably safe conditions throughout the Ripon planning area. Continual evaluation and the use of new fire fighting techniques and equipment should pressure and promote increased safety in the area.



RIPON CONSOLIDATED FIRE DISTRICT

Exhibit 4

RIPON EMERGENCY PLAN

The Emergency Services Operational Plan for the City of Ripon is basically an extension of the California Emergency Plan. The plan covers emergency situations in a general way, and names the titles of the people who would be called upon in an emergency. Perhaps an addendum to the plan should be prepared and continually updated with specific names and phone numbers, in an effort to achieve greater coordination. Each section should also have what is called an "annex," which sets out the functions and responsibilities in more detail, with alternate position heads. More importantly, those annexes should contain the standard operating procedures for each department, such as how to mobilize each department on a 24-hour basis. An Emergency Services Operational Plan needs either viable annexes or viable contingency plans.

The City of Ripon should consider holding meetings at intervals to reconsider and update the Emergency Plan, to insure that each person knows what they are supposed to do, and what their responsibilities are. Disaster drills are quite effective in pointing out discrepancies and inefficiencies in emergency plans.

INUNDATION MAPPING AND EVACUATION PLANNING

Senate Bill 1632, signed May 31, 1974, requires that inundation maps must be prepared for dams that would affect populated areas should they fail; and that the Office of Emergency Services shall determine that those areas possibly affected have adequate public safety measures for the evacuation and control of those populated areas.

Emergency procedures must conform to local needs, and may include the following elements:

1) delineation of area to be evacuated;
2) routes to be used;
3) traffic control measures;
4) shelters to be activated for the care of the evacuees;
5) methods for the movement of people without their own transportation;
6) identification of particular areas or facilities in the flood zones which will not require evacuation because of their location on high ground or similar circumstances;
7) identification and development of special procedures for the evacuation and care of people from unique institutions;
8) procedures for the perimeter and interior security of the area, including such things as passes, identification requirements, and antilooting patrols;
9) procedures for the lifting of the evacuation and re-entry of the area; and
10) details of which organizations are responsible for these functions and the material and personnel resources required.

These procedures should be reviewed at least every two years.

Ripon will most likely be in an area that would be inundated should Melones or New Melones Dam fail. Evacuation seminars, sponsored by the State Office of Emergency Services are scheduled to take place in San Joaquin County in October or November, 1975. Once these seminars are held, that information should be added to the Safety Element.

IDENTIFICATION OF EXISTING PROGRAMS

Below are listed programs and activities having significant actual or potential capability for implementing the Safety Element:

County Programs

Building Regulations
Disaster Preparedness
Fire Protection
Flood Control
Geologic Mapping
Land Division Regulations
Taxation
Zoning Regulations

Special District Programs

Rural Fire Districts
Resource Conservation Districts

City Programs

Building Regulations
Disaster Preparedness
Fire Department
Taxation
Zoning Regulations

State Programs

Fire and Rescue Emergency Plan
Geologic Research & Mapping
Taxation
Water Supply Management
California Fire Incident Reporting System

Federal Programs

FIRESCOPE
Forest Service
Geologic Survey & Research
Taxation

Other Implementation Activities & Problems

Community Relations
Coordination & Review
Legislation
Long Range Planning
Mutual Assistance
Public Education
Research & Monitoring

PRIORITIES FOR ABATEMENT OF SAFETY HAZARDS

Priorities for abatement of safety hazards for the City of Ripon should concentrate on those hazards found to be in the "unacceptable risk" category and the "avoidable risk" category. A citizens committee (perhpas the well established Safety Council) should review this Safety Element and the COG Safety Element, and work to establish priorities on the abatement of hazards according to various considerations of risk and a cost-effect criteria in the planning area of Ripon.

Criteria for establishing these priorities are:

1 - significant threat to life and property
2 - major threat to dependent populations or large concentrations of people
3 - desirability for taking advantage of an opportunity before it is lost

Priority action areas might include:

1 - public information
2 - coordination
3 - dependent populations
4 - emergency response
5 - flood areas
6 - fire hazardous buildings
7 - industrial fire hazards
8 - residential fire hazards
9 - brush fire hazards
10 - geologic hazards

CONCLUSION

The recognition and appraisal of hazards is the first step toward increasing the quality of life for the citizens of Ripon. This element has identified two basic hazard areas for the Ripon area (fire and flooding; geologic hazards are covered by the Ripon Seismic Safety Element). The COG element identifies fire, crime and flood hazards as they apply to the entire county.

With the appraisal of these hazards, the City of Ripon should set up an implementation program with recommendations for the area itself.

APPENDIX:

FLOOD PRONE AREA

IMPACT MITIGATION CHART

To help coordinate safety considerations with comprehensive planning, the following chart on flood prone areas is offered, which details the impact of flooding on particular types of land use, and specific mitigation measures.*

*Charts are from Development Guidelines for Areas of Statewide Critical Concern, Volume II, Impact Charts, Prepared by Jones & Stokes Associates, Inc., Sacramento, California, for Office of Planning and Research, State of California, July 1974.

LAND USE		FLOOD PRONE AREAS
CATEGORY	TYPE	100-YEAR FLOOD PLAIN
RESIDENTIAL	Rural density Low density Urban/suburban Transient lodging	Impacts Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Public safety hazard; possible loss of life during floods. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Increased or more rapid runoff of storm water due to vegetation removal, soil compaction, impervious surfaces, etc. Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Flood insurance (currently provided by the Federal Insurance Administration of HUD). Preparation of evacuation plans with information distributed to affected persons. Watershed management to reduce flood intensity. Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas. Elevate structures above expected flood level. Flood-proofing of structures as outlined in U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses, Volume 2. Minimize vegetation removal, soil compaction, creation of impervious surfaces.

LAND USE		FLOOD PRONE AREAS
CATEGORY	TYPE	100-YEAR FLOOD PLAIN
INDUSTRIAL	Petroleum and chemical products Wood and paper products Food processing Other manufacturing	Impacts Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from petroleum products, chemicals, wood pulp, organic wastes, heavy metals, etc., washed into stream. Public safety hazard; possible loss of life during floods. Potential disruption of community economic activity from flood damage. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Increased or more rapid runoff of storm water due to vegetation removal, soil compaction, impervious surfaces, etc. Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Preparation of evacuation plans with information distributed to affected persons. Watershed management to reduce flood intensity. Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas. Elevate structures above expected flood level. Flood-proofing of structures as outlined in U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses, Volume 2. Minimize vegetation removal, soil compaction, creation of impervious surfaces. Store chemical products in flood proof structures or outside floodplain.

LAND USE CATEGORY	LAND USE TYPE	FLOOD PRONE AREAS: 100-YEAR FLOOD PLAIN
COMMERCIAL	Small scale trade and services Large scale trade and services	<u>Impacts</u> Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Public safety hazard; possible loss of life during floods. Potential disruption of community economic activity from flood damage. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Increased or more rapid runoff of storm water due to vegetation removal, soil compaction, impervious surfaces, etc. <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Flood insurance (currently provided by the Federal Insurance Administration of HUD). Preparation of evacuation plans with information distributed to affected persons. Watershed management to reduce flood intensity. Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas. Elevate structures above expected flood level. Flood-proofing of structures as outlined in U. S. Water Resources Council, <u>Regulation of Flood Hazard Areas to Reduce Flood Losses</u>, Volume 2. Minimize vegetation removal, soil compaction, creation of impervious surfaces.

LAND USE CATEGORY	LAND USE TYPE	FLOOD PRONE AREAS: 100-YEAR FLOOD PLAIN
RESOURCE DEVELOPMENT	Grazing	<u>Impacts</u> Potential damage to or loss of livestock, fences, equipment, roads, etc. during flood. Economic loss to property owners, insurance companies, government. Possible public health hazard from drowned livestock. <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Schedule grazing in floodplain for periods of low hazard potential.
	Intensive animal husbandry	<u>Impacts</u> Potential damage to or loss of buildings, fences, roads, livestock, etc. during flood. Potential downstream water pollution from animal wastes washed into stream; accelerated erosion from barren ground. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Public health hazard from drowned livestock. <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Plan for the transfer of livestock to other areas during periods of potential flooding.

LAND USE CATEGORY	LAND USE TYPE	FLOOD PRONE AREAS: 100-YEAR FLOOD PLAIN
	Liquid waste disposal facilities	Impacts Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from poorly treated sewage sludge, treatment chemicals, etc., from sewage treatment facilities. Possible disruption of electrical power supply to service area during flood. Economic loss to property owners, insurance companies, government. Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Flood-proofing of structures as outlined in U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses, Volume 2. Provision for tie-in to other power sources in case of facility shut-down.
TRANSPORTATION	Railroads and highways Airports	Impacts Potential damage to transportation facilities from flood. Public safety hazard; possible loss of life during floods. Economic loss to property owners, insurance companies, government. Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Watershed management to reduce flood intensity.
	Commercial watercraft transportation and facilities	Impacts Potential damage to harbor facilities, ships, etc. from flood. Public safety hazard; possible loss of life during floods. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Flood insurance (currently provided by the Federal Insurance Administration of HUD). Watershed management to reduce flood intensity. Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas. Elevate structures above expected flood level. Flood-proofing of structures as outlined in U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses, Volume 2.

LAND USE CATEGORY	LAND USE TYPE	FLOOD PRONE AREAS: 100-YEAR FLOOD PLAIN
	Impoundments	Impacts Regulation of or great reduction in frequency of flood flows (seldom eliminates flood potential). Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Inundates reservoir area, forcing relocation of land uses. Mitigation Measures Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity.
	Channelization and drainage	Impacts Promotes more rapid drainage of area, increased peak flows. Usually increases land values or otherwise leads to subsequent pressure for additional development in the hazard area. Mitigation Measures Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity.
UTILITIES	Power generation facilities	Impacts Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from fuel sources washed into stream. Possible disruption of electrical power supply to service area during flood. Economic loss to property owners, insurance companies, government. Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Flood-proofing of structures as outlined in U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses, Volume 2. Provision for tie-in to other power sources in case of facility shut-down.

LAND USE CATEGORY	LAND USE TYPE	FLOOD PRONE AREAS: 100-YEAR FLOOD PLAIN
	Transmission facilities, above-ground pipelines and aqueducts	Impacts Possible damage to facilities from flood. Potential downstream water pollution from ruptured pipelines. Possible loss of service to facility customers during flood. May increase land values or otherwise lead to subsequent pressure for additional development in the hazard area. Mitigation Measures Floodproof facilities.
	Buried pipelines	Impacts Floodwaters may expose and damage pipelines — potential for subsequent water pollution from ruptured pipelines, loss of service to facility customers. May increase land values or otherwise lead to subsequent pressure for additional development in the hazard area. Mitigation Measures Route pipeline to avoid areas of high erosion potential during flood periods. Structural design to withstand flood pressures.
	Solid waste disposal facilities	Impacts Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from solid wastes, sediments, leachate from landfills and dumps. Disruption of disposal service and potential public health hazard in service area during flood. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas. Flood-proofing of structures as outlined in U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses, Volume 2.

LAND USE		FLOOD PRONE AREAS
CATE-GORY	TYPE	100-YEAR FLOOD PLAIN
	Cultivated agriculture	<u>Impacts</u> Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from agricultural chemicals washed into stream, accelerated erosion, etc. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. Deposition of sediments on agricultural land <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Use crops which can be planted and harvested during periods of low flood hazard.
	Forestry activities	<u>Impacts</u> Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from accelerated erosion on cut-over slopes, tannic acids leached from logging debris, etc. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased or more rapid runoff of storm water due to vegetation removal, soil compaction. Forestry activities in upper watershed areas may increase flood frequency in lower watershed areas. <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Follow state logging practices regulations and guidelines.

LAND USE		FLOOD PRONE AREAS
CATE-GORY	TYPE	100-YEAR FLOOD PLAIN
	Oil and gas extraction	<u>Impacts</u> Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from liquid waters associated with drilling washed into stream. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). May increase land values or otherwise lead to subsequent pressure for additional development in the hazard area. <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Flood-proofing of structures as outlined in U. S. Water Resources Council, <u>Regulation of Flood Hazard Areas to Reduce Flood Losses</u>, Volume 2. Conduct drilling during periods of low flood hazard.
	Mining	<u>Impacts</u> Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood Potential downstream water pollution from leachate from mines, erosion of mine wastes. Public safety hazard; possible loss of life during floods. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream). Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs. <u>Mitigation Measures</u> Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity. Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas. Place spoil storage areas outside of floodplain.

<table>
<tr><th colspan="2">LAND USE</th><th>FLOOD PRONE AREAS</th></tr>
<tr><th>CATE-GORY</th><th>TYPE</th><th>100-YEAR FLOOD PLAIN</th></tr>
<tr><td rowspan="5">RECREATION</td><td>Enclosed cultural and recreational centers</td><td><u>Impacts</u>

Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood.

Public safety hazard; possible loss of life during floods.

Economic loss to property owners, insurance companies, government.

Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream).

Increased pressure or necessity for structural flood control measures with attendant economic and environemntal costs.

May increase land values or otherwise lead to subsequent pressure for additional development in the hazard area.

<u>Mitigation Measures</u>

Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency.

Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons.

Watershed management to reduce flood intensity.

Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas.

Elevate structures above expected flood level.

Flood-proofing of structures as outlined in U. S. Water Resources Council, <u>Regulation of Flood Hazard Areas to Reduce Flood Losses</u>, Volume 2.</td></tr>
<tr><td>Outdoor recreational activities requiring substantial environmental modification</td><td><u>Impacts</u>

Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood.

Potential downstream water pollution from chemicals, fuels, etc. washed into stream.

Public safety hazard; possible loss of life during floods.

Economic loss to property owners, insurance companies, government.

Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream).

May increase land values or otherwise lead to subsequent pressure for additional development in the hazard area.

<u>Mitigation Measures</u>

Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency.

Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons.

Watershed management to reduce flood intensity.

Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas.

Flood-proofing of structures as outlined in U. S. Water Resources Council, <u>Regulation of Flood Hazard Areas to Reduce Flood Losses</u>, Volume 2.</td></tr>
</table>

<table>
<tr><th colspan="2">LAND USE</th><th>FLOOD PRONE AREAS</th></tr>
<tr><th>CATE-GORY</th><th>TYPE</th><th>100-YEAR FLOOD PLAIN</th></tr>
<tr><td rowspan="2"></td><td>Outdoor recreational activities requiring little environmental modification</td><td><u>Impacts</u>

Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood.

Public safety hazard; possible loss of life during floods.

Economic loss to property owners, insurance companies, government.

<u>Mitigation Measures</u>

Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency.

Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons.

Watershed management to reduce flood intensity.</td></tr>
<tr><td>Resorts and group camps</td><td><u>Impacts</u>

Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood.

Public safety hazard; possible loss of life during floods.

Economic loss to property owners, insurance companies, government.

Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipes, etc., damage to banks, levees, other structures downstream).

Increased pressure or necessity for structural flood control measures with attendant economic and environmental costs.

<u>Mitigation Measures</u>

Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency.

Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons.

Flood insurance (currently provided by the Federal Insurance Administration of HUD).

Watershed management to reduce flood intensity.

Prohibition of changes in topography or placement of structures which could worsen flood damages to other areas.

Elevate structures above expected flood level.

Flood-proofing of structures as outlined in U. S. Water Resources Council, <u>Regulation of Flood Hazard Areas to Reduce Flood Losses</u>, Volume 2.</td></tr>
</table>

LAND USE		FLOOD PRONE AREAS
CATE-GORY	TYPE	100-YEAR FLOOD PLAIN
	Off-road vehicle use	Impacts Potential damage to or loss of buildings, fences, equipment, roads, etc. during flood. Potential downstream water pollution from accelerated erosion from disturbed and denuded areas. Public safety hazard; possible loss of life during floods. Economic loss to property owners, insurance companies, government. Possible downstream damage or disruptions caused by debris or other objects swept away during flood (stream channel obstructions, blockage of gates, drains, intake pipelines, etc., damage to banks, levees, other structures downstream). Mitigation Measures Structural measures such as dams, levees, channel enlargement, bypasses, etc., to reduce flood frequency. Flood forecasting (currently provided by the National Weather Service) combined with system for notifying potentially affected persons. Watershed management to reduce flood intensity.